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HUMAN MORPHOMETRICS, MOTION, AND PERFORMANCE RESEARCH

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This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

The voluntary informed consent of the subjects used in this research was obtained as required by Air Force Instruction 40-402.

This technical report has been reviewed and is approved for publication.

FOR THE COMMANDER

Kenneth R Boff

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This report is the last in a series of 14 quarterly progress reports under Air Force Contract F33615-89-C-0572. Over the course of the three-and-a-half year contract period, the work was focused on a wide variety of tasks which were all united by a common theme: the application of one-, two-, and three-dimensional anthropometric data to problems of design and personal protection. The tasks that were active during the final quarter are reported here in detail, but these represent only a subset of all the tasks carried out over the entire contract period. This report includes an index to tasks reported in the preceding 13 reports.

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PREFACE

This document is the final report for a research contract spanning three-and-one-half years. Incremental progress was reported in quarterly reports throughout the period, and in the interest of brevity and conserving resources, that earlier material is not presented here. However, an index to those earlier is provided here. Requests for access to previously reported research should be directed to Kathleen M. Robinette, Armstrong Laboratory, Wright-Patterson Air Force Base, Ohio 45433-7022.

The author list for this report consists of those who contributed materially to the research, however, this work builds substantially on work that has gone before. It is therefore appropriate to recognize the contributions of those who worked on this program in previous quarters. The authors gratefully acknowledge the work of the following individuals: Charles E. Clauser, Shirley Kristensen, John T. McConville, and Phillip Walker, Anthropology Research Project, Inc.; Robert M. Beecher, Beecher Research Company; Jerome Brainard, Robert Bolia, and Kevin Nuse, Systems Research Laboratories, Inc.; Dennis Burnsides, Sytronics, Inc.; Joseph Nurre, Ohio University; Makarand V. Ratnaparkhi, Wright State University. From Anthropology Research Project, Inc., Ilse O. Tebbetts edited and revised the text of this report and all previous quarterly reports. Belva M. Hodge and Jennifer Schinhofen prepared this and previous report manuscripts.

The work reported here and in previous reports was guided throughout by Kathleen M. Robinette, the technical monitor of this contract. Other valuable assistance was provided by Capt John T. Crist, Jennifer J. Whitestone, and Gregory F. Zehner, all of Armstrong Laboratory.

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SUMMARY

This report is the last in a series of 14 quarterly progress reports under Air Force Contract F33615-89-C-0572. Over the course of the three-and-a-half year contract period, the work was focused on a wide variety of tasks which were all united by a common theme: the application of one-, two-, and three-dimensional anthropometric data to problems of design and personal protection. The tasks that were active during the final quarter are reported here in detail, but these represent only a subset of all tasks carried out over the entire contract period. This report includes an index to tasks reported in the preceding 13 reports.

A study to determine whether automated methods of obtaining anthropometric data are more reliable than traditional methods was designed and partially completed. The experimental design and data analysis procedures are reported here. The analysis is separated into two phases: the repeatability of traditional anthropometry and the repeatability of laser scanner anthropometry.

One of the most time consuming tasks associated with processing scanner images of heads is the identification of the subject's anatomical landmarks on the scanned images. A blackboard system has been developed to automate this process. Major effort during the final reporting period was applied to the development of high-reliability knowledge sources for use in the blackboard system. This report summarizes the current state of the blackboard system and identifies the direction needed for future work.

A number of tasks were undertaken to support the Helmet-Mounted Systems Technology (HMST) program office. The fit assessment of the HGU-53/P helmet received the most attention during this period. A measuring team travelled to four Air Force bases and collected data from 185 subjects. Data were collected on: traditional anthropometry, laser scan, helmet fit, and sound attenuation. As the data were collected only a short time before the contract period concluded, detailed analysis is not provided here.

Fit assessment were also done for the Advanced Technology Anti-G Suit (ATAGS). The measurement team travelled to five Air Force bases and collected data from 269 air crew. As with the HGU-53/P evaluations, data collection was completed only days before the end of the contract period, so analysis is not reported here.

To improve the effectiveness of the Computerized Anthropometric Research and Design (CARD) Laboratory, we began a structured analysis of the functions and goals of the laboratory. The functions of the laboratory were structured into an Enterprise Model in the previous reporting period. During this period, problems and approaches to solving them were identified for the four highest level functions in the laboratory. These high level functions are: Provide Research and Services; Promote the Laboratory; Provide Software and Hardware Support; and Manage the Laboratory. A structured approach to solving the problems is presented.

Work continued on the cockpit accommodation database, and significant tasks were completed. The initial version of the database on the VAX was completed, and validation of the algorithms for the F-16A and C-141A are underway. The database was ported to INFORMIX, a

SUMMARY (cont'd)

UNIX-based DBMS, so that it can be operated on the Silicon Graphics (SG) workstations. This serves the laboratory's long-term goal of becoming hardware independent. A procedures document, covering both the initial collection of the accommodation data and its subsequent analysis, has been prepared in draft form, and will be included in the database available on the SG. Additionally, we developed a prototype software program to facilitate the input of raw reach data from the field. While currently residing on the VAX, subsequent versions will be available for a DOS-based laptop so it can be easily used in field situations.

In the area of cockpit accommodation analysis, a technical report, entitled "Anthropometric Accommodation in Aircraft Cockpits: A Methodology for Examination," was submitted for review. Additionally, our subcontractor conducted a follow-on cockpit evaluation of the T-38 aircraft, and conducted a technical review of a U.S. Navy report, "Procedural Guide to Aircrew Anthropometric Accommodation Assessment," TM 92-74 SY.

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INTRODUCTION

Although the research outlined in the Air Force RFP for this three-and-a-half-year contract period was differentiated into 12 separate tasks, a central theme common to much of the work was the collection, processing, and use of three-dimensional anthropometric data.

With the capability for gathering 3-D data well-established, at least with respect to head and face segments of the body, completion of the minisurveys of Air Force and Navy aviator personnel presented few unforeseen problems. Most of the research challenges during this time were focused on finding ways to access and use 3-D data. Great strides were made in the development and improvement of the INTEGRATE program which now enables users to visualize, manipulate, and edit such data on-screen, and to calculate measurements such as point-to-point distances and volumes. Considerable progress was also made in automatic landmark identification of both marked and unmarked points through the use of color and outline recognition techniques.

The growing 3-D database was added to the CARD laboratory's data system, and software was modified and improved to enable users to access and use this information. As yet unresolved is the problem of summarizing 3-D data, although a number of methodologies investigated during this contract period may yet prove to bear fruit. Among them are a mathematical approach known as curvature analysis (Ratnaparkhi); a computerized technique which seeks to determine an "average face," (Beecher); and KRIGing, a method which produces, in effect, three-dimensional regression equations (Robinson and Grant).

The ability to scan and record head/face shape was put to use in a number of studies conducted for the Air Force and its contractors. In one such study, for example, investigators established facial clearances available between helmet and mask for the design and placement of optical equipment such as night vision goggles. In another, representative heads were selected from scan data files for use in the construction of generic head forms. In still another application, the scanning capability was used to study face casts of aviators with atypical faces with the aim of minimizing the need for custom masks.

A sizable number of clothing and personal protective items were evaluated in the past three years. Major efforts included fit evaluations of Navy and Air Force womens' uniforms, for purposes of creating size selection charts, establishing tariffs, and providing guidance for the design and modification of patterns. In a joint Air Force/Navy project, a variety of helmet-mounted systems were tested to determine fit, comfort, and optical function of these ensembles. Updated fit testing procedures were documented in various ways — among them an in-house guide for creating SAS formatted files, and a draft manual designed for use by the Air Standardization Coordinating Committee (ASCC).

A somewhat different form of fit testing was carried out during the three-year cockpit accommodation study in which subjects were used as "tools" to establish body-size parameters for functioning safely and effectively in a variety of aircraft. Techniques for collecting and analyzing these data were developed and applied in field studies involving nearly a dozen U.S. and many foreign aircraft. Methods for establishing cockpit accommodation limitations for overhead clearance, ejection clearances, rudder-pedal operation, visual access, and hand reach to controls, were documented in a draft technical report along with results of studies conducted on specific aircraft.

Tri-service matters received considerable attention during this contract period. Matching procedures developed by ARP and Air Force personnel were used to assess the possibilities of standardizing sizing for Army, Navy, and Air Force clothing, with promising results. Work was also done on identifying a headform best suited to represent the U.S. military population, and on determining the feasibility of developing a single analogue or family of models to represent tri-service females.

Under contract to the Air Force, ARP developed and maintained the much-used AAMRL data bank which, for many years, supplied body size information to the Air Force and to many other users. This contract period has seen the rapid development of the next-generation anthropometric resource: the CARD data base system. Maintenance, up-dating, and improvement of this facility have been on-going tasks throughout this contract period. Adding new survey data, upgrading memory and graphics, improving software required to access and use data, and conducting various SAS and statistical analyses in support of numerous other projects have been among our on-going tasks. An updated CARD users guide was published as AL-TR-1992-0036. Attention has also been given to updating multivariate models which have increasingly come to supplant percentiles in solving a variety of design problems.

Finally, on-going support services provided by ARP staff and subcontractors included evaluation and installation of new hardware and software, and maintenance of both old and new computer systems.

All of the work completed during the contract period has been described in detail in a series of 13 progress reports. This final report describes the tasks completed during the past three months. An index provides a guide to descriptions and reports of all the earlier work by task and project.

Staff

During this reporting period the staff of the Anthropology Research Project (ARP) was made up of the following people:

Bruce Bradtmiller .... President
Belva M. Hodge .... Business Manager
James F. Annis .... Senior Research Associate
Henry W. Case .... Research Associate
Daniel Mountjoy .... Research Associate
Sherri Upchurch Blackwell .... Research Associate
Thomas Churchill .... Senior Computer Programmer
Shirley Kristensen .... Research Assistant
Teresa Mayfield .... Research Assistant
Ilse Tebbetts .... Editor/Technical Writer
Jennifer A. Schinhofen .... Secretary

Travel

On 7-24 July 1993, Dan Mountjoy and Bob Bolio travelled to Ft. Walton Beach, Florida for the HGU-53/P fit evaluation. On 1-14 August 1993, Henry Case and Sherri Blackwell travelled to Nellis AFB, Nevada for the ATAGS fit testing. On 1-21 August 1993, Dan Mountjoy and Bob Bolio travelled to Shaw AFB, South Carolina for the HGU-53/P fit evaluation. On 23-30 August 1993, Henry Case and Sherri Blackwell travelled to Langley AFB, Virginia for the ATAGS fit testing. Also, on 13-25 September 1993, Henry Case and Sherri Blackwell travelled to Tyndall AFB, Florida for the ATAGS fit testing.

Major Purchases

Quantity	Item	Amount	Task Number
1	Optical Disk Cartridge	$499.00	12

TECHNICAL DISCUSSION

The statement of work for this contract calls for a series of separate but interrelated tasks. Each of these tasks is discussed below.

TASK 1 ...shall perform an anthropometric survey of USAF personnel using a three-dimensional measuring device provided by the Air Force....The survey plans shall include sampling for age, race, sex, job category, and rank, and their effect on body size...

Work under this task was not initiated.

TASK 2 ...shall conduct analyses in order to determine the three- dimensional locations of specific anatomical landmarks; consistent and repeatable methods of defining and locating these structures or points must be derived...Data editing shall include...visual inspection...of datasets...as well as a more thorough inspection of the data after the survey is complete. Initial data analysis shall include the calculation of point-to-point distances, arcs, and circumferences...

Reliability Study of Head and Face Measurement Methods

The advent of automated methods of obtaining anthropometric data, raises the question of how these methods compare with traditional anthropometry. A study to answer this question with regards to linear head measurements was designed and partially completed. The ultimate goal of the study was to determine which method of gathering anthropometric data is most reliable. This draft report documents the experimental design and data analysis procedures for this study. The data analysis is

separated into two phases: the repeatability of traditional anthropometry, and the repeatability of scanner anthropometry.

Dimensions and Landmarks

Linear measurements were the focus of the study, because of their simplicity. With arcs and circumferences there is the question of whether the measurement should follow or span the hollow of the body. For instance, for a waist circumference, should the tape follow the hollow of the back or should it span the hollow. The question becomes more critical when dealing with scans, because it is necessary to tell the software how to calculate the measurement using the scan data. The following measurements were taken in the experiment: menton-sellion length, glabella-pronasale, minimum frontal breadth, bizygofrontale breadth, bizygomatic breadth, bitragion breadth, bigonial breadth, and interpupillary distance. Anatomical landmarks associated with these dimensions are: frontotemporale, glabella, gonion, menton, pronasale, pupil, sellion, tragion, zygion, and zygofrontale.

Experimental Design

Three people trained as landmarkers and measurers participated. One person ran the scanner, three served as data recorders, three served as landmarkers/measurers, and another three people served as subjects.

In the experimental design, three markers marked each subject three times. Each time a subject was marked by a marker, each of three measurers measured the subject twice and the subject was scanned twice. The experimental design for one subject and one marker is shown in Tables 2.1 and 2.2.

In order to actually conduct the experiment, it was necessary to schedule the marking and measuring sessions so that all three landmarkers/measurers and subjects could be working simultaneously and so that data collection could be broken up into sections spanning several days with breaks to reduce the memory effect. Therefore, the schedule shown in Table 2.3 was developed. In this schedule, data collection was divided into three trials containing three phases. Each phase represents the marking of each subject by one landmarker and the measuring of each subject by each measurer twice.

In one trial of three phases each subject was marked one time by each landmarker, scanned six times, and measured six times by each measurer. The purpose of conducting three trials was to allow each landmarker to mark each subject three times. By the completion of three trials, each subject had been marked three times by each landmarker, measured 18 times, and scanned 18 times by each measurer. In summary, there were three subjects with 54 repeated measures each of traditional anthropometry.

The experimental data were gathered in 4.5 days. For four days, two phases of a trial were conducted. Data were collected in one morning and one afternoon session per day. On the fifth day, data were collected in one afternoon session.

TABLE 2.1

Traditional Anthropometry
Experimental Design for One Subject, One Marker

Subject	Marker	Marking Session	Measurer	Measuring Session
	(LNDMRKR)	(TRIAL)	(MEASR)	(REP)
1	1	1	1	1
				2
			2	1
				2
			3	1
				2
		2	1	1
				2
			2	1
				2
			3	1
				2
		3	1	1
				2
			2	1
				2
			3	1
				2

TABLE 2.2

Scanner Anthropometry
Experimental Design for One Subject, One Marker

Subject	Marker	Marking Session	Scan Session	Picker	Picking Session
1	1	1	1	1	1
					2
				2	1
					2
				3	1
					2
			2	1	1
					2
				2	1
					2
				3	1
					2
		2	1	1	1
					2
				2	1
					2
				3	1
					2
			2	1	1
					2
				2	1
					2
				3	1
					2
		3	1	1	1
					2
				2	1
					2

TABLE 2.3

Schedule of Events for Each Trial of the Experiment

Marker/Measurer	M1	M2	M3
Phase 1			
Subject Marked/Scanned	S1	S2	S3
Subject Measured	S1	S2	S3
	S3	S1	S2
	S2	S3	S1
	S1	S2	S3
	S3	S1	S2
	S2	S3	S1
Phase 2			
Subject Marked/Scanned	S3	S1	S2
Subject Measured	S3	S1	S2
	S2	S3	S1
	S1	S2	S3
	S3	S1	S2
	S2	S3	S1
	S1	S2	S3
Phase 3			
Subject Marked/Scanned	S2	S3	S1
Subject Measured	S2	S3	S1
	S1	S2	S3
	S3	S1	S2
	S2	S3	S1
	S1	S2	S3
	S3	S1	S2

The data collection schedule was as follows:

Day 1: Trial 1, Phase 1 and Trial 1, Phase 2

Day 2: Trial 1, Phase 3 and Trial 2, Phase 1

Day 3: Trial 2, Phase 2 and Trial 2, Phase 3

Day 4: Trial 3, Phase 1 and Trial 3, Phase 2

Day 5: Trial 3, Phase 3

Data Analysis

Statistical Methods:

In a single group situation with one repeated measures factor and k repeated measures, the univariate repeated measures analysis is a two-way mixed effects model with subjects as a random effect and the repeated measures factor as a fixed effect. Several repeated measures factors were studied in this analysis. Not all interactions between them are of interest because in some cases: (1) the analysis was rendered powerless due to a small number of error degrees of freedom, and (2) interactions did not make sense and were uninterpretable. Furthermore, the repeated measures factors were treated as random effects rather than fixed effects, because variance components were estimated.

The statistical assumptions common to a univariate single group repeated measures design are:

(1) Independence of subjects

(2) Multivariate normality

(3) A linear model

(4) Sphericity

Sphericity occurs when the variances among all possible pairwise differences of the levels or treatments on the repeated measures factors are equal. It is reasonable to assume that the repeatability data satisfy the four assumptions required for a univariate analysis.

Each anthropometric dimension was examined separately for significant effects and for estimates of variance components. A significance level of .05 was used to test for significant effects.

The plan was to divide the analysis of the experimental data into two parts: Determining repeatability for traditional anthropometry, and determining the repeatability of scanner anthropometry.

Repeatability of Traditional Anthropometry

The main questions to by answered by this analysis were:

(1) How great is the variation among the repeated measures as a result of the landmarking process?

(2) How great is the variation among the repeated measures as a result of the measuring process?

Sources of error expected to affect the variability in traditional anthropometry and of interest to this study were the landmarking process (within and between landmarker) and the measuring process (within and between measurer).

The repeatability of traditional anthropometry for linear head measurements was measured using analysis of variance with subjects blocked and three within-subject factors (trial with three levels, landmarker with three levels, and measurer with three levels). The dependent variables consisted of the eight anthropometric dimensions producing eight separate univariate analyses.

A random effects model was appropriate because we were not interested in making inferences about the three landmarker/measurers. We were interested in the population of landmarker/measurers. With a random effects model, the variance of subject, trial, and repetition can be estimated using the error sums of squares since all interactions involving these factors are assumed to be insignificant as they do not make sense. Since the interaction between landmarker and measurer was being tested, the variance of landmarker and of measurer could be estimated using the error sums of squares for their interaction.

The proportion of the total variance due to trial was the between-trial or within- landmarker error. The proportion of the total variance due to landmarker was the between- landmarker error. The proportion of the total variance due to measurer was the between- measurer error. The proportion of the total variance due to repetition was the between- repetition error or within-measurer error.

There were 162 (3 trials x 3 landmarkers x 3 measurers x 2 repetitions x 3 subjects) observations and 161 degrees of freedom (d.f.) for univariate statistical analysis of traditional anthropometry. The sums of squares can be partitioned into the following terms:

Subject	(2 d.f.)
Landmarker	(2 d.f.)
Subject*Landmarker	(4 d.f.)
Trial	(2 d.f.)
Subject*Trial	(4 d.f.)
Trial*Landmarker	(4 d.f.)
Subject*Trial*Landmarker	(8 d.f.)
Measurer	(2 d.f.)
Subject*Measurer	(4 d.f.)
Landmarker*Measurer	(4 d.f.)
Subject*Landmarker*Measurer	(8 d.f.)

Trial*Measurer	(4 d.f.)
Subject*Trial*Measurer	(8 d.f.)
Trial*Landmarker*Measurer	(8 d.f.)
Subject*Trial*Landmarker*Measurer	(16 d.f.)
Repetition	(1 d.f.)
Subject*Repetition	(2 d.f.)
Landmarker*Repetition	(2 d.f.)
Subject*Landmarker*Repetition	(4 d.f.)
Trial*Repetition	(2 d.f.)
Subject*Trial*Repetition	(4 d.f.)
Trial*Landmarker*Repetition	(4 d.f.)
Subject*Trial*Landmarker*Repetition	(8 d.f.)
Measurer*Repetition	(2 d.f.)
Subject*Measurer*Repetition	(4 d.f.)
Landmarker*Measurer*Repetition	(4 d.f.)
Subject*Landmarker*Measurer*Repetition	(8 d.f.)
Trial*Measurer*Repetition	(4 d.f.)
Subject*Trial*Measurer*Repetition	(8 d.f.)
Trial*Landmarker*Measurer*Repetition	(8 d.f.)
Subject*Trial*Landmarker*Measurer*Repetition	(16 d.f.)

To test for significant within-subjects effects, the p-values for the univariate unadjusted F tests are given below for each anthropometric dimension (labeled M1 through M8) and each within-subjects factor:

Effect	M1	M2	M3	M4	M5	M6	M7	M8
Trial	.01	.11	.00	.18	.11	.15	.35	.75
Landmarker	.00	.01	.00	.00	.57	.01	.00	.29
Measurer	.00	.00	.00	.00	.00	.00	.00	.00
Repetition	.57	.83	.31	.87	.15	1.0	.39	.93
Interaction	.53	.95	.96	1.0	.99	.69	.87	.02

M1=Promenton-Sellion Lth
M2=Glabella-Pronasale Lth
M3=Min Frontal Brdth
M4=Bizygofrontale Brdth
M5=Bizygomatic Brdth
M6=Bitragion Brdth
M7=Bigonial Brdth
M8=Interpupillary Brdth

With a .05 significance level, Trial is significant for Promenton-Sellion Lth and Min Frontal Brdth. Landmarker is significant for all dimensions except Bizygomatic Brdth and Interpupillary Brdth. Measurer is significant for all dimensions. Repetition is insignificant for all dimensions. The Landmarker/Measurer interaction is insignificant for all dimensions except Interpupillary Brdth which is considered a fluke, because pupils are not landmarked.

The SAS procedure VARCOMP was used to estimate the variance components of the model for each dimension. They showed that the estimated variances for Trial, Landmarker, Measurer, Repetition, and the interaction between Landmarker and Measurer were near zero or very small for all

anthropometric dimensions except for Bigonial Breadth. Estimated variances of Landmarker and Measurer were quite high relatively speaking. This outcome was not surprising as Bigonial Breadth was considered the hardest dimension to landmark, because the bigonion landmarks are not very pronounced in some people. It was also the hardest to measure, because there may be a lot of tissue in the area on some people making it quite sensitive to the amount of pressure applied by the measurer.

The overall conclusion for this part of the study was that linear measurements of the head and face obtained through traditional measuring techniques are quite repeatable for measurements defined by easily distinguishable landmarks that are not surrounded by much tissue.

Repeatability of Scanner Anthropometry:

This part of the study was not completed, but it was designed as follows:

There will be 324 (3 landmarkers x 3 trials or landmarking sessions x 2 scanning sessions x 3 point pickers x 2 picking sessions x 3 subjects) observations (323 d.f.) for statistical analysis of scanner anthropometry.

Sources of error that are expected to affect the variability in scanner anthropometry and that are of interest to this study are the landmarking process (within and between landmarker), the scan point picking process (within and between point picker), and the scanner point randomization. Scanner point randomization refers to the fact that when two identical bodies are scanned, the resulting scanned images will not be identical due to a random error in the scanner.

The scanner anthropometry will consist of point-to-point distances between landmarks. These point-to-point distances will be comparable to the traditional anthropometric measurements mentioned above.

The repeatability of scanner anthropometry for linear head measurements can be measured using an analysis of variance with subjects blocked and five within-subject factors (trial with three levels, landmarker with three levels, scanning session with two levels, point picker with three levels, and point picking session with two levels). The dependent variables consist of the eight dimensions producing eight separate univariate analyses.

Using a random effects model, the variance of each factor can be estimated. The proportion of the total variance due to marking session is the within-landmarker error. The proportion of the total variance due to landmarker is the between-landmarker error. The proportion of the total variance due to scanning session is scanner point randomization error. The proportion of the total variance due to point picker is the between-point-picker error. The proportion of the total variance due to point picking session is the within-point-picker error.

Comparison of Traditional and Scanner Anthropometry:

To determine the repeatability of traditional measuring techniques versus computerized measuring techniques, we believe that the estimated variances for each method of anthropometric measurement can be statistically compared, measurement by measurement. Research will have to be conducted to develop the exact methodology for doing this.

TASK 3 ...shall develop automated methods of extracting specific measurements from high density, three-dimensional datasets...These methods shall be capable of extracting distance data between both pre-marked specific points and specific points which have not been pre-marked...

Blackboard Systems

Work continued on Dr. Randy Pollack's blackboard system. Initial rework was complete. Major effort during the final reporting period was applied to development of robust high-reliability knowledge sources. The focus was on identifying which landmark is associated with each of the blue spots. As work progressed, more and more possibilities for exploiting the data were recognized. For instance, with "positive" identification of the midsagittal landmarks (Glabella, Sellion, Pronasale, and sometimes Promenton), it has become possible to identify the exact midsagittal longitude with absolute certainty. The present state of the blackboard system is as follows:

a. The neck and top-of-head are being positively identified. These algorithms have been tested on a small sample of the HGU-53/P survey.

b. The midsagittal longitude is being estimated using the previously discussed algorithm which depends on head length > head width. This algorithm appears less certain on the HGU-53/P data than on the minisurvey data, due to an apparent tendency of the subjects to tilt their heads in the HGU-53/P survey, and due to slightly less precise positioning of the heads with respect to the center of scan. This algorithm works most of the time on a small sample of the HGU-53/P data, but appears less reliable than was hoped.

c. The midsagittal longitude is being estimated using the median longitude of the blue-colored spots. The original (FIT) algorithm used the average, which proved too sensitive to the nuchale and various noise points. The new algorithm works on many of a small sample of HGU-53/P subjects, but its reliability has not yet been quantified.

d. The combination of algorithms b and c above has proved 100% reliable in correctly identifying the midsagittal longitude on the small sample of HGU-53/P subjects examined so far. The blackboard works since it successfully combines two knowledge sources to produce a better result than either one can obtain individually.

e. Using the knowledge of the midsagittal longitude, an algorithm has been developed which reliably identifies the pronasale for any scan in which the head is approximately upright (Frankfort plane nearly horizontal). This algorithm has been tested on three scans from the minisurvey and a small subset of the HGU-53/P data, with very high reliability.

f. An algorithm has been developed which uses knowledge of the midsagittal longitude and the position of the pronasale to assign blue-colored spots to midsagittal landmarks. The center of the spot closest to the identified pronasale position is added as a

hypothesis for the pronasale position. The closest spot above the pronasale spot is hypothesized to be the sellion, and the next spot above the sellion is hypothesized to be the glabella. If a midsagittal spot occurs below the pronasale, it is hypothesized to be the promenton. Surprisingly, a large percentage of the scans examined so far (possibly approaching 50%) appear to have problems with the promenton. Not too surprisingly, few scans have a detectable menton spot, and so far, no scans have detectable submandibular spots.

Future work will be to identify the remaining blue spots, probably using the statistical information developed for use with the constraint network.

After all blue spots are successfully being identified, work will turn to identifying other landmarks, such as subnasale (first minimum below pronasale?), supramenton (first minimum above promenton?), and stomion (minimum between two close maximums above supramenton and below subnasale?).

Dr. Pollack's plan for future Blackboard development appears as a report in Attachment 3.1.

ATTACHMENT 3.1

Areas for Additional Development of the Blackboard System

Short Term

1. Add a constraint network, incorporating relationships between landmarks (the sellion is below the glabella, etc.), statistical data on those relationships (the min, max, average distances and standard deviation between the sellion and the glabella on previous scans) for use by the blackboard system. The network will help in determining the confidence that the system has in its hypotheses, and possibly it will also be used in the generation of new hypotheses.

2. Investigate the idea of separating hypotheses into latitude hypotheses and longitude hypotheses rather than posting a set of coordinates. This is due to the fact that some knowledge sources have expertise in finding either latitude or longitude but not both. Currently, these knowledge sources must post both coordinates, so they have to "make up" the one they don't really know about, not differentiating the confidence that they have in these two different coordinates. The Integrating Knowledge Sources, when looking at a hypothesis, cannot currently tell whether the latitude or longitude location was the focus of the knowledge source that posted it. This information should improve the performance of the Integrating Knowledge Sources.

3. Develop and improve the Integrating Knowledge Source algorithms, and integrate the use of the constraint net into the algorithms. In addition, develop the ability of the Integrating Knowledge Sources to manipulate hypotheses - remove old hypotheses, alter confidence levels, etc.

4. Use bounding boxes (regions) rather than specific locations in hypotheses. The bounding box should be a class with a set of methods including SET, SAME_AS, INTERSECTION, IS_POINT, and possibly others.

5. Develop a list of strategies used to find each landmark.

6. Evaluate existing knowledge sources, modify as necessary, and develop new knowledge sources in the following areas:

   - Use patches more extensively to find landmarks
   - Use the constraint network to generate hypotheses
   - Use color data more extensively to find landmarks

7. Evaluate the use of differently colored patches on non-landmark locations to help in confirming landmark or region positions.

Intermediate Term

8. Regional Knowledge Sources - allow the system to focus on one area of the head, such as eye, mouth, etc.

Long Term

9. Control Blackboard and Knowledge Sources - implement dynamic priorities, allowing the system to try different strategies, foci, etc. by monitoring the results of the problem-solving process.

Constraint Network

The constraint network will be an auxiliary data structure that is part of the blackboard data. There will be one node for each landmark, and they will be indexed by landmark number. Each constraint node will contain the following statistics:

	Neighbor	MaxDiff	MinDiff	AvgDiff	StdDeviation
Lat >					
Lat <					
Lon >					
Lon <					

In addition, each node will include a bounding box which will contain the current bounds of the region that must contain that landmark.

The concept of the constraint network is that each landmark will be linked to up to four different neighbors, which are those landmarks that are related to it in the following ways: (1) the nearest neighbor that must have a lower latitude, (2) the nearest neighbor that must have a higher latitude, (3) the nearest neighbor that must have a lower longitude and (4) the nearest neighbor that must have a higher longitude. For example, the pronasale would be linked to the subnasale, sellion, and possibly the right and left chelions. These relationships must be true 100% of the time, because these links will be used to propogate constraints from one landmark node to another. The bounding boxes in the constraint network will be "firm" information; we are confident with a very high degree of probability that the landmark location is within the bounding box. In contrast, bounding box locations in hypotheses are not firm; a knowledge source with only one strategy has posted a belief that the landmark is in that bounding box.

The constraint net will be used by the POST_HYPOTHESIS routine to help set the confidence value of each hypothesis. If the hypothesized location is outside the bounds of the boundary box in the constraint net node, it will have a very low confidence value.

It will also be used by a new knowledge source to combine the statistical data with known landmark locations to extrapolate the regions in which related landmarks should be found. Based on preliminary investigation, it is possible that the maximum and minimum differences may not be useful information because of (1) possible errors in the existing data, and (2) the extreme cases which make the regions defined by max and min too large to be useful. It may be more productive to use the average + 2 standard deviations (or 3 standard deviations if we want a higher probability of being correct) to generate bounding box hypotheses for linked landmarks.

Current Strategies for Locating Landmarks

1. RTragion

Define a region 10 lats above and 15 below infraorbitale and defined by infraorb longitude + 75 and the max number of radii in a region (MaxRadii). Look for a very negative slope toward the front of the region. (KS 66)

2. RZygion

3. RInfraZygion

4. RGonion

5. RMidlatInfrMan

6. RFrontotemp

Patch in a region defined by LFrontotemporale and glabella. (KS 84)

Patch in a region defined by glabella. (KS 80)

7. RZygofrontale

Patch in region defined by LZygofrontale. (KS 86)

Patch in region defined by RFrontotemporale. (KS 83)

8. RInfraMalar

Patch in a region defined by LInframalar. (KS 77)

Patch in a region defined by pronasale and stomion. (KS 67)

9. REctocanthus

Color data and pupil location. (KS 94)

10. REndocanthus

Color data and pupil location. (KS 93)

Neural net on a region defined by right infraorbitale (KS 70)
(KS doesn't get called - doesn't work)

* REndo is posted based on LEndo and sellion (KS 64)

Lat slopes are used, with the sellion and glabella as reference points. The endocanthus lon is hypothesized to be 4 lats past the point at which the slope down from the nose stops.
* Endocanthus lat is hypothesized to be 7 below the sellion (KS 57)

11. RInfraorb

Patch in a region defined by RInframalar (KS 68)

12. Glabella

Latitude of the highest max feature is located, then the patch nearest the midsag plane at that lat is picked as the glabella. (actually more complicated than that, but this logic will work once we know the midsag plane) (KS 60)

13. Sellion

Slope change above the pronasale. (KS 73)

14. Pronasale

Slope change above subnasale. (KS 75)

First max feature above the subnasale (KS 56)

15. Subnasale

Slope change above the stomion. (KS 74)

First min feature above the stomion (KS 55)

16. Promenton

Maxes, Mins and Patches are used to locate midsagittal plane and then the promenton is located by finding the longest Max feature (KS 52)

Menton

* Menton is 10 lats below the promenton (KS 54)

18. RChelion

Color data and stomion location. (KS 95)

* Rchelion is posted based on LChelion (KS 62)

First min at the stomion lon is followed to its end; chelion lon is hypothesized at the end of the min feature. (KS 59)

Lat slopes are used to locate chelion by working outward from stomion lon and following first positive then negative shopes.
* Chelion latitude is posted as stomion lat - 4. (KS 58)

19. Stomion

Slope changes in the area defined by midsag plane above promenton (KS 72)
* The Min feature closest to 23 lats above the promenton (KS 53)

20. LChelion

Color data and stomion position. (KS 91)

* Hypothesize Lchelion based on Rchelion position (KS 61)

First min at the stomion lon is followed to its end; chelion lon is hypothesized at the end of the min feature. (KS 59)

Lat slopes are used to locate chelion by working outward from stomion lon and following first positive then negative shopes.
* Chelion latitude is posted as stomion lat - 4. (KS 58)

21. Submandibular

Slope changes on the midsag plane below the promenton (KS 71)

22. LInfraorb

Patch in a region defined by RInframalar. (KS 79)

23. LEndocanthus

Left pupil and color data. (KS 89)

* LEndo is posted based on sellion and REndo (KS 63)

Lat slopes are used, with the sellion and glabella as reference points. The endocanthus lon is hypothesized to be 4 lats past the point at which the slope down from the nose stops.
* Endocanthus lat is hypothesized to be 7 below the sellion (KS 57)

24. LEctocanthus

Color data and left pupil location. (KS 90)

25. LMidlatInfrMan

26. LFrontotemp

Patch in a region defined by RFrontotemp and glabella. (KS 85)

Patch in a region defined by the glabella. (KS 81)

27. LZygofrontale

Patch in a region defined by RZygofrontale. (KS 87)

Patch in region defined by LFrontotemporale. (KS 82)

28. LInfraMalar

Patch in a region defined by RInframalar. (KS 78)

Patch in a region defined by the stomion. (KS 76)

29. LZygion

30. LInfraZygion

31. LGonion

32. LTragion

Define a region based on LInfraorbitale; look for very negative slope toward the front of the region. (KS 69)

33. Nuchale

34. RPupil

Color data and sellion location. (KS 92)

35. RSupraEcto

36. RSupraPupil

37. RSupraEndo

38. LPupil

Color data in latitudes near the sellion. (KS 88)

39. LSupraEcto

40. LSupraPupil

41. LSupraEndo

42. SupraMenton

Supramenton is found using min features at lease 5 lats above promenton (KS 65)

TASK 4 ...shall develop and evaluate sizing systems for new, modified, or existing items of personal protective equipment and clothing including some uniform items...The contractor shall develop estimated procurement tariffs (estimates of how many people will wear each size), and estimated size assignment criteria...

Helmet Mounted Systems Technology

Task HEG-1: Fit Envelope Definition

Headforms:

Although initially considered acceptable, continued examination of scans of the first headform received from Advent Programming indicated that the headform did not match the data files from which the headform was made. A careful review of the original data and the headform data revealed that a vertical inaccuracy in the scanning process was responsible for the incongruity between the sets of data. (This vertical inaccuracy may have been introduced when the new color system was installed in the scanner.) Because the vertical increment is a parameter of the original set-up file for the scanner itself, it was not possible to reset the parameter within that file. It was possible, however, to correct the increment in the header of each scan file by running the file through the software program, INTEGRATE. Once the vertical inaccuracy was corrected in the original scan files, it was possible to properly evaluate the accuracy of the additional eight headforms.

The eight headforms received from Advent Programming during the last reporting period were scanned and then visually compared to the data sets from which they were made. The headform scans closely match the original data sets.

HGU-53/P Fit Assessment

Background:

The Air Force is considering replacing the current flyer's helmet (HGU-55/P) with the HGU-53/P. This survey was conducted to test a modified sizing system for the HGU-53/P based on a laboratory fit test conducted with a civilian population at Wright-Patterson Air Force Base. The survey was also conducted in support of the design of next generation night vision goggles and helmet mounted displays which will be using the HGU-53/P as a platform. Results of the preliminary fit test at Wright-Patterson indicated redundancy in the sizing system; specifically, two of the helmet sizes (sizes 3 and 5) could accommodate the same population as well as the available six sizes.

HGU-53/P Preliminary Fit Test:

The objectives of the preliminary fit test were to determine: 1) whether any sizes can be eliminated from the sizing system, and 2) what anthropometry is key to size selection. The data analysis from the preliminary fit test resulted in a new size selection scheme that was incorporated into the HGU-53/P survey.

The data for subject 20 was dropped from the analysis due to biased responses. Therefore, the sample consisted of 50 civilian subjects.

Data Scores:

Each subject was tested in his/her T.O. (Technical Order) size, the next size smaller, and the next size larger. The resulting fit data from the questionnaire were used to score the sizes as either "pass" (the helmet fit) or "fail" (the helmet did not fit).

The data were then combined into an overall pass/fail score for each subject in each size tested. If a subject received a fail for any one of the above questions, then the overall score for that size was a "fail." In other words, for a size to pass, it had to get a pass for all the questions. Using these criteria, it was possible, in fact likely, for a subject to score a pass in more than one helmet.

Size Elimination:

To potentially eliminate a size from the system, all subjects who received a pass in that size were arbitrarily assigned to another size in which they also received a pass. If a subject did not receive a pass in another size in the system, then the subject was considered "not accommodated" by the proposed new sizing system.

It was initially suggested that every other size might be eliminated from the sizing system. When sizes 2, 4, and 6 were eliminated, nine subjects were not accommodated. Examination of the data for those subjects showed that five failed in size 1, passed in size 2, but were not tested in size 3 because they wore T.O. size 1. We suspected that these subjects would have received a pass in size 3, so they were assigned to that size. Another subject who wore T.O. size 3, failed in sizes 2 and 3, passed in size 4, but was not tested in size 5. We suspected that this subject would have received a pass in size 5, so he/she was assigned to that size. The other three subjects did not receive a pass in any size in which they tested; these were the only subjects not accommodated by a system with sizes 1, 3, and 5. One of these subjects had extremely large head dimensions and failed in sizes 5 and 6. This suggests that another size which is larger than size 5 might be needed, especially since the dimension specifications for those sizes are identical.

Since none of the subjects who were not accommodated passed in helmet size 1, it is also reasonable to eliminate size 1 from the system. The final sizing system consists of sizes 3 and 5. A comparison of the original technical order and the modified sizing system is provided in Table 4.1.

TABLE 4.1

Comparison of Technical Order and Modified Sizing Systems

Technical Order Sizing System		Modified Sizing System	
Head Circumference (cm)	HGU-53/P Size	Head Circumference (cm)	HGU-53/P Size
53.34 - 54.61	1	< 55.0	3
54.61 - 55.88	2	> 55.0	5
55.88 - 57.15	3		
57.15 - 58.42	4		
58.42 - 59.69	5		
59.69 - 60.96	6		

Key Dimensions for Size Selection:

A bivariate plot of head breadth and head circumference showed that sizes 3 and 5 were well defined by head circumference. A single exception was a subject with a head circumference of 555 mm, who was assigned to size 5 in the midst of many size 3's. This subject, unlike most of the other subjects, was quite experienced with wearing helmets. It is reasonable to expect that this data are more representative of the data that will be gathered on pilots during future fit tests. It is also expected that many of the subjects assigned to size 3 above the 550 mark would have received a pass in size 5 had they been tested in it and had they been pilots. There is also the possibility that there is no real difference in fit between sizes 3 and 5.

HGU-53/P Survey:

Four bases were selected as test sights for the HGU-53/P helmet fit evaluation: Griffiss AFB, NY; Eglin AFB, FL; Hurlburt Field, FL; and Shaw AFB, SC. Ten to eleven subjects per day were scheduled at each of the first three sites, and eight per day at Shaw AFB. The evaluation team spent two weeks each at Griffiss AFB and Shaw AFB and one week each at Eglin AFB and Hurlburt AFB. The goal was to collect data on 250-300 subjects. However, due to difficulties encountered by the scheduler at Griffiss AFB, and a one-day shut- down due to equipment problems at Hurlburt Field, a total of 185 subjects were processed during the survey. Only one female participated as a subject.

Procedure:

Traditional Anthropometry:

Subjects were briefed as to the purpose of the survey and asked to sign a voluntary consent form. Following the briefing, the subjects were landmarked for traditional anthropometry of the head and face. Blue paper dots were placed over each landmark to be used for automatic landmark picking at a later time. Seventeen different dimensions were measured with no head covering, and five repeated after the subject was fitted with a bald cap.

The following landmarks were located on each subject:

Glabella	Zygion
Sellion	Infrazygion
Pronasale	Tragion
Promenton	Inframalar
Menton	Gonion
Frontotemporale	Mid Inframandibular
Zygofrontale	Nuchale
Infraorbitale	Mastoid

Three-Dimensional Anthropometry:

Once the traditional anthropometry was finished, the subjects (wearing the bald caps) were scanned with the 3-D digitizer. A black cape was placed about the subjects' neck and

shoulders to eliminate any possible artifacts from their flight suits that would interfere with the automatic landmark picking procedure. The scanned image was viewed to determine whether the subject moved, and if needed, the scan was repeated.

Helmet Fitting:

Each subject was custom fit with a thermal plastic liner (TPL) by life support personnel from Brooks AFB. The fitting process involves heating the TPL in an oven until it begins to melt, and subsequently placing the TPL on the subject's head. The TPL is then covered by a fitting shell of the same shape as the inside of the HGU-53/P. A weighted ring is hung on top of the shell and kept in place for about two minutes in order to compress the layers of the TPL into the correct shape. When this process is complete, the edges of the TPL are cut to match the fitting shell, it is inserted into a cloth cover, and attached by Velcro inside the helmet shell. The subjects then donned the helmet to verify proper ear cup placement. Subjects whose head circumferences fell between 55 and 56 cm were asked to wear both sizes (3 and 5) of helmets to help clarify the position of the dividing line in the modified sizing system. Therefore, these subjects were fit with two different helmet liners.

Sound Attenuation:

Once satisfied with the ear cup placement, a sound attenuation study was performed with both the HGU-55/P and the HGU-53/P helmet. Sound attenuation was used as a fit indicator based on the premise that too little attenuation indicates that a helmet is loose on the sides of the head. The subject was asked to sit between two stereo cassette players placed at head level. Broad band noise was played through each stereo system at sound pressure levels (SPL) of approximately 110 dB. Baseline SPL measurements were taken at each ear while the subject wore only ear plugs. The subject was then instructed to don the HGU-53/P. At this time the noise level was measured inside each ear cup of the helmet. If the sound attenuation was deemed insufficient (i.e., SPL readings greater than or equal to 89 dB inside the ear cup), pads were added behind the ear cups of the HGU-53/P to create a tighter seal against the head. The measurements were repeated and then performed in a like manner with the HGU-55/P (no additional padding was added to the HGU-55/P). A set of Bose Active Noise Reduction (ANR) ear cups were installed into an HGU-53/P helmet at Shaw AFB and were tested with the ANR both active and passive. The active test was discontinued due to lack of proper equipment for realistic attenuation measurement (the microphone attached to the Sound Pressure Level meter used for measuring the noise levels was too large and interfered with the microphone used inside the ANR ear cups themselves).

Fit Evaluation:

Following the attenuation test, the subjects were asked to wear the helmet for fifteen minutes, at which time a fit evaluation was performed. The subjects were asked a series of questions regarding tightness and comfort of the shell and the earcups. A stability test was conducted by applying two pounds of force upwards from the helmet's rear edge roll. The magnitude of the deflection was measured on the forehead. Following the evaluation, subjects were asked to record any comments they had about the HGU-53/P, in general, and how it compared to their current helmet. Finally, subjects were scanned in the HGU-53/P and in their

the HGU-53/P shell before the scan so that they could be evaluated later in conjunction with the data from the unhelmeted scan.

Combat Edge Questionnaire:

A late addition to the survey was a questionnaire on the Combat Edge mask. This was initiated at Shaw AFB where 42 subjects had flown sorties with the mask. Those subjects were asked to identify the location of any hot spots they experience from the mask, at which points stickers were placed. These subjects were also scanned while wearing the Combat Edge mask.

Results:

Results of the HGU-53/P Survey were not compiled by the end of this contract period.

Task CFH-02: Concept VI Optical System Fit Assessment

Scheduling conflicts with the trained optical specialist who was to assist in the Concept VI fit assessment continued to delay the dry-run testing of that optical system. These delays prevented further work on this task under this contract.

Determination of the Preferred-Line-of-Sight

Although the needed equipment (the RK416 Pupil Tracking System and the Rose Imaging Surface Scanner) was identified, money was not available on this contract for its purchase. Therefore, work on this task was not completed by contract end.

Evaluation of the Advanced Technology Anti-G Suit (ATAGS)

Data collection for ATAGS was completed during this reporting period. Fit assessments were conducted on 54 pilots at Nellis Air Force Base, 20 pilots at Langley AFB and 65 pilots at Tyndall AFB. Demographic data from the first four test sites are presented in Table 4.2.

Changes in ATAGS Evaluation

Initial analysis of data from Randolph AFB and Laughlin AFB revealed the need to revise the rating procedure for ATAGS in order to distinguish between suits which did not fit in the waist, and suits which did not fit in the waist as well as in multiple other areas. Because the Technical Order (T.O.) for ATAGS states that suit fit is dictated by waist fit, any subject for whom the waist did not fit received a "5" rating. Therefore, a size rated "5" with a fit evaluation performed represents a non-fit by T.O. standards but does not necessarily suggest that major alterations would have to be made to that pattern in order to afford the subject an acceptable fit in that size. (In other words, the waist does not fit, but other areas of the G-suit do.) Accordingly, a size rated "5" with no evaluation performed represents a non-fit not only by T.O. standards, but also suggests that major alterations must be made to the pattern in order to afford the test subject an acceptable fit in that size.

TABLE 4.2

ATAGS Demographic Data

AIR FORCE BASE	FREQUENCY	PERCENT
Randolph	61	29.9
Laughlin	69	33.8
Nellis	54	26.5
Langley	20	9.8
Total	204	100.0

SEX	FREQUENCY	PERCENT
Male	200	98.0
Female	4	2.0
Total	204	100.0

RACE	FREQUENCY	PERCENT
White	200	98.0
Black	3	1.5
Other	1	0.5
Total	204	100.0

AGE GROUP	FREQUENCY	PERCENT
20-24	56	27.5
25-29	63	30.9
30-34	70	34.3
35-39	12	5.9
40-44	3	1.5
Total	204	100.0

Changes in Sock Evaluation

A review of the data from Randolph AFB and Laughlin AFB also indicated the need to evaluate an additional dimension for the ATAGS sock. The unique shape of the sock made it too narrow for many subjects across the widest part of the foot. For this reason, a new dimension, Width at Foot Breadth, was added to the list of areas evaluated on the sock.

Both the revised "5" (or "unable to don") rating for the G-suit and the new sock dimension were incorporated in the data collection procedures at Nellis, Langley, and Tyndall Air Force Bases.

Analysis

Analysis of the ATAGS data was not performed under this contract due to the fact that data collection was completed only days prior to contract end.

TASK 5 ...shall fabricate three-dimensional forms of body segments...ranging from as small as a hand to as large as a whole body clothing manikin...

This task was largely inactive during the current contract period.

TASK 6 ...shall maintain and update the on-line CARD anthropometric database...The contractor shall document how to use the modified database...

CARD Lab Function and Goals

This document presents overall observations and recommendations made by our subcontractor, Micah Systems, Inc., based on the interviews and analysis conducted at the CARD Lab. It is intended to provide guidance as the Lab takes subsequent steps in developing and adopting information technologies.

This report has been structured around the four highest level functions in the CARD Lab Enterprise Model. Problems observed in these functional areas have been addressed and approaches to solving them are proposed.

Provide Research & Services

- This functional area is at the heart of the Lab's mission. Much of the Lab's current efforts are in this area -- 13 of 31 lower level functions shown on the Function/Goals Matrix (see Appendix A) fall into this area.

- Many of the goals identified by Lab staff are aimed at improving and enhancing this functional area -- 28 of 42 lower level goals are supported by functions in this functional area. However, virtually all of the goals, if accomplished, will ultimately enhance the Lab's ability to provide research and services to its customer base.

- The Lab has numerous goals that would advance anthropology in general, and specifically contribute to the medical applications area. However, the Lab needs to do much more to accomplish these goals. Goals such as:

  - 2.3.3 Compare Surface of Objects
  - 2.4 Develop Finite Element Tools
  - 2.5 Develop Bio-Mech. Modeling
  - 2.6 Move Towards Virtual Reality

  are receiving minimal functional support.

- We have identified five key leverage points in this functional area. [We define a key leverage point as a lower level function that supports the accomplishment of numerous and varied goals.]

Function	Goals Supported
1.1.1.1 Formulate Question	12
1.1.1.2 Hypothesize Approach	12
1.1.1.3 Prototype Approach	10
1.1.1.4 Test Method	10
1.1.6 Serve on Working Groups	22

Promote Lab

- This functional area is becoming a more important aspect of the Lab operation as DoD budgets shrink and dual use technologies are increasingly emphasized. The medical and healthcare industry is one in which there is a possible synergy with CARD Lab expertise and which is growing in importance in national policy considerations.

- The Lab is doing much to advance in this functional area. Advertising, participating on national and international working groups, educating users and designers, participating on standards committees, and delivering papers and presentations at conferences and symposia all contribute to promoting the Lab, even though the primary purpose of some of these functions is something other than promotion. However, the Lab should develop a service strategy (see Goal 4.1). Such a strategy is critical to the success of this functional area, but developing one currently receives minimal functional support; and no current function has that as a primary focus. A service strategy should guide the Lab's promotional efforts in terms of target markets and service offerings. Results of a survey of potential users are given in Appendix B.

- Many of the goals intended to enhance this functional area (goals under 4.0 Expand Market and Services) are receiving significant support. However, Goal 4.2.3 Educate Lab Personnel and Goal 4.6 Maintain Global Awareness are receiving minimal functional support. Of these two, Goal 4.2.3 Educate Lab Personnel, which is focused on training Lab personnel about the design process and what designers need, should, no doubt, be receiving more support given that it can have a significant impact on accomplishing the core mission of the Lab.

- We have identified one key leverage point in this functional area.

Function	Goals Supported
2.2 Educate Users and Designers	9

- Some activities undertaken by Lab personnel contribute to both functional area 1.1 Advance Anthropology and functional area 2.0 Promote Lab, even though they may only be shown in the functional area related to their primary purpose. These include:

  - Publish/Present Results
  - Serve on Working Groups
  - Establish Standards

Problem: The Lab does not have a defined service strategy (or "marketing plan") by which to guide the efforts at promoting the Lab. Without such a plan, the efforts of Lab staff and the allocation of resources will not be as focused as with a plan.

Recommendation: Take the steps necessary to accomplish Goal 4.1, the intent of which is to develop a strategy for providing services to Lab customers. This strategy should detail the markets, potential customers, and customers to be targeted, the services each of these may need, the approach to be followed in promoting Lab services to these customers, the resources required and the timeframe over which the marketing will take place.

Provide SW/HW Support

- This is an absolutely critical element of the Lab's operation. This functional area is not only a leverage point for goal accomplishment, it is also a leverage point supporting many of the other Lab functions. Information technologies, including computer hardware, software, databases, and access to communication networks, play a central role in the Lab's vision. And these technologies will only increase in importance with growth in the quantity and complexity of Lab data repositories.

- The Current System Assessment Matrix indicates a lack of integration. The Matrix shows two major computing platforms and two major DBMSs. Current tools support segmented user groups, with minimal cross over. For example, the Cockpit Accommodation users have their own system and the Fit Testing/Analysis users have their own system. Among other drawbacks, a lack of system integration typically results in:

  - higher system maintenance costs
  - more effort required to answer questions which cut across the enterprise
  - difficulty in incorporating new system functionality
  - difficulty in sharing data across the enterprise.

- Given the Lab's vision, mission and goals, the CARD Lab has taken an important step in issuing an RFP for an on-line system of anthropometric and human system interface data. However, this RFP did not stress the need for integration in the data system architecture.

The Lab should ensure that the proposed development effort results in an integrated data system.

- We have identified six key leverage points in this functional area.

Function		Goals Supported
3.1	Monitor Technological Trends	13
3.3.1	Determine Requirements	12
3.3.2	Evaluate & Select SW/HW	10
3.4	Develop I.S. Methods	14
3.5.1	Develop Routines	20
3.5.2	Develop Data Systems	16

- The Lab needs to evaluate and select an environment as a base for developing the new CARD Lab Data System. Components of this development environment include:

  - Computer Aided Software Engineering (CASE) Tools
  - Database Management System (DBMS) - relational and object oriented
  - Computing Environment (Silicon Graphics)
  - Data Administration
  - Development Methodology.

The elements of this development environment should be selected to fit together and complement each other.

- Data Administration plays a very important role in the development environment. Data Administration is responsible for developing standards for data naming, ensuring adherence to those standards, eliminating synonyms, homonyms and redundant data elements, coordinating data naming across a project team or development group, and contributing to data analysis and design. Our review of a list of measurement numbers and titles in the CARD Database indicates that data administration is required. For example, we found the following:

1013	RACE-AFW68
1037	RACE-AFM67
1039	RACE-AFM65
1042	RACE-ARW77
1052	RACE-NAVY88
1053	RACE-ARMY88
1063	RACE-MINI

These all appear to be the same data element, race. If so, then only one field is required, not seven. Based on our brief review, this is not an isolated example.

- The Lab needs to develop plans for the migration from the VAX computing platform, which currently runs SAS, the RIM database management system, the CARD Database, and the Cockpit Accommodation Database. The Digital VAX computing platform and the

software and databases which run on the VAX are clearly very important to the Lab. Therefore, careful planning is required for the transition away from the VAX to ensure that there is a smooth migration to a new computing platform and that the computing requirements currently satisfied by the VAX platform continue to be met without interruption. This transition planning should be done in conjunction with the planning for the new CARD Lab Data System, to the extent possible. The target environment (including DBMS, hardware platform, etc.) for the new system should be identified before the migration of VAX systems is undertaken.

- Data collection is frequently done at sites remote from the Lab; for example, at an Air Force base while doing a fit study. The future integrated CARD Lab Data System should be designed to make this very easy. Mobile data entry routines should be designed around the same database management system and user interface as the integrated Data System. The integrated Data System should include an option for easy upload of data from the laptop.

- Information Engineering is a structured systems development methodology that has as its underlying purpose the development of systems that fit the business context. The boundaries of the business context can be documented in the form of a vision, mission, and goals of the enterprise, the functions performed by the enterprise, and the data required by the enterprise to perform those functions. We have prepared this level of documentation for the Lab in the form of the Mission and Goals Hierarchy and the Enterprise and Conceptual Data Models. The next steps for the Lab in using these documents to drive the development of an integrated data system are:

  - Complete the planning steps for goal accomplishment proposed in the Function/Goals Matrix. Doing so will help further define data requirements [to be reflected in the Conceptual Data Model (Appendix C)], as well as any new functions that need to be added to the Enterprise Model (Appendix D).

  - Carry data and process analysis and design to the next level of detail. See Figure 6.1 for an overview of the Information Engineering Approach that embodies the necessary steps.

Object Oriented Development:

- The Lab has shown some interest in object oriented development, primarily through the use of C++. While these techniques and tools may offer some advantages to the Lab, they are far from mature. Currently there is no strong integrated object oriented toolset commercially available.

- Using our knowledge of the Lab, we completed a quiz[1] designed to help determine whether object oriented database management or relational database management would be the

[1] Baum, David, "Object-oriented databases: Are they for you?," Computerworld, Vol. 27, No. 24, June 14, 1993, pp. 109, 116.

better choice for a given situation. The results of this quiz indicated that object oriented database management would be best for the Lab. The key issues in this consideration for the Lab were:

- storage and use of 3D images
- storage and use of design information from/for CAD, CAM, or CIM applications
- current use of object oriented development tools (C++).

We recommend that the Lab investigate both relational and object oriented database management systems to determine which best meets its requirements for data storage, retrieval, management, and processing. The evaluation and selection of database management systems should be done in conjunction with the evaluation and selection of supporting computer aided software engineering (CASE) tools.

The Lab Conceptual Data Model could be implemented under either of these approaches to data management.

- Below we have listed a number of leading object oriented methodologies and object oriented CASE tools[2]. The Lab's investigation and selection of an appropriate development environment should include consideration of these object oriented alternatives, as well as object oriented database management systems.

Object Oriented Methodologies:

- Object Modeling Technique (Rumbaugh)
- OOD (Shlaer - Mellor)
- ObjectOry (Ivar Jacobsen)
- Object - Oriented Design (Booch)

Object CASE Toolsets:

- Objectory -- Objective Systems
- Rose -- Rational Systems, Inc. (Rose is tied to Booch methodology)
- TeamWork -- Cadre Technologies, Inc.

Problem: The Lab anticipates losing the Digital VAX computing environment by the end of 1993. As far as we know, the Lab has done little planning for the migration from the VAX to another computing environment.

Recommendation: Given the importance of the VAX computing environment to the Lab, it is absolutely essential that the Lab develop plans for the migration away from the VAX. However, the Lab should not develop these migration plans in isolation from the planning necessary to put in place the development environment for the new CARD Lab Data System. Two of the most important pieces

[2] Radding, Alan, "To methodology or not to methodology?," Computerworld, Vol. 27, No. 24, June 14, 1993, p. 114.

in this plan are the evaluation and selection of statistical analysis software and database management software.

Problem: The Lab's current information technology infrastructure is not integrated. In addition, the RFP for the new CARD Lab data system did not stress the need for integration in the data system architecture.

Recommendation: The Lab should take the necessary steps to ensure that components of any new systems are integrated. Figure 6.2 depicts the facets of integration of importance to the CARD Lab:

- system capabilities
- categories of data
- categories of users.

System capabilities and data resources should be designed so that they fit together seamlessly and are easily available to users, whether those users are accessing the system from within the Lab (internal users), from an external agency or organization (external users), or Lab personnel who are on TDY assignment for a survey or other Lab business (mobile users).

<u>Manage Lab</u>

- The use of a project management package (such as TimeLine) could improve Lab operations if it were used consistently and regularly to schedule the workload of all contractor personnel and if the resulting schedules were made available to Government and contractor personnel. These schedules could be used as the basis for communicating and agreeing upon Lab priorities and allocating the resources consistent with those priorities.

- We have identified two key leverage points in this functional area.

Function		Goals Supported
4.1	Manage Lab Budgets	39
4.2.2	Manage Workload	25

INFORMATION ENGINEERING APPROACH

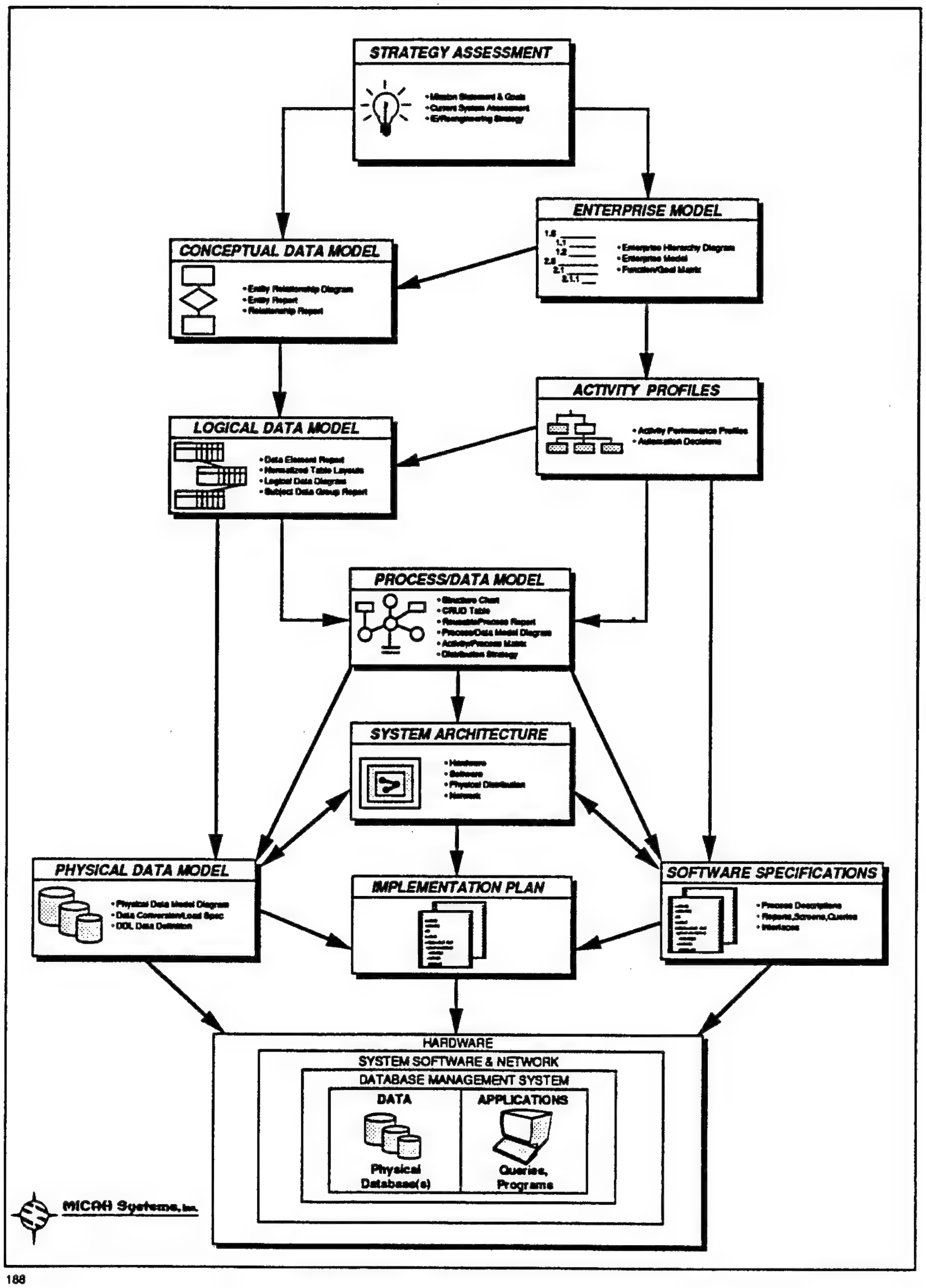

FIGURE 6.1

Information Engineering Approach

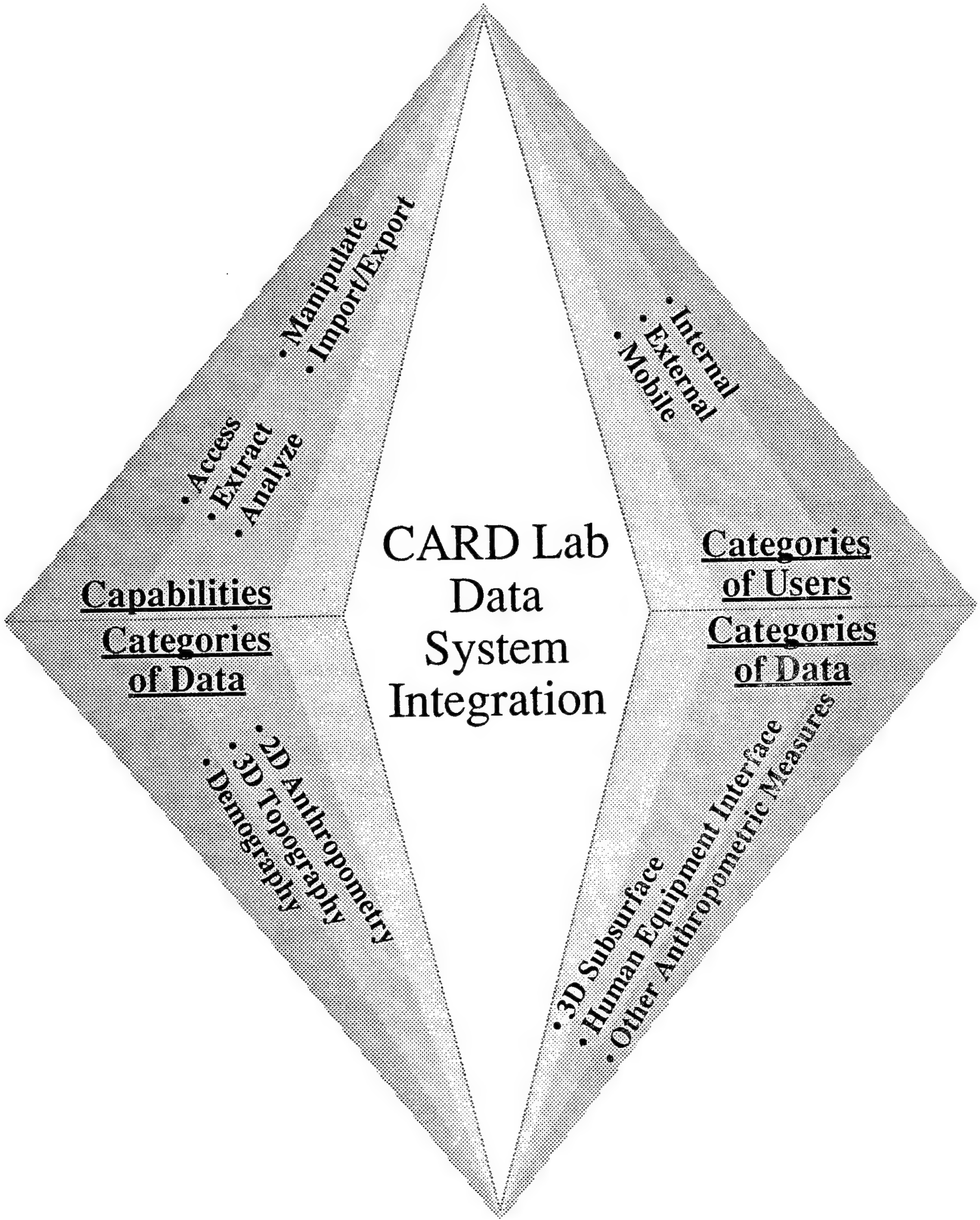

FIGURE 6.2

Facets of Integration

These functions clearly affect all aspects of the Lab and will be instrumental in accomplishing numerous goals. However, it is our assessment that the Lab needs to improve in this area, particularly in managing workload (Function 4.3.2). We further explore this issue in the following points.

- We have observed minimal support by this functional area for the following goals:

- Goal 5.1 Enhance Staff Skills
- Goal 5.2 Prioritize Lab Activities
- Goal 5.3 Improve Communications
- Goal 5.4 Improve Workload Management

- Most of the Lab "staff" are contractor personnel. Contractor personnel are basically organized as a general resource pool available to do work for any of the key Government Lab personnel.

Problem: The Lab appears to have minimal management structure. Contractor personnel are not well informed about the vision, mission, and goals of the Lab. They do not appear to know what the priorities of the Lab are. They appear to be pulled between extremes -- at times not enough work to do, and at times too much work to do for several Government personnel.

Recommendation: Government Lab personnel should take the lead in instituting a Lab management structure that includes the following elements:

- agreement among key Government Lab personnel on Lab priorities, work assignments, and allocation of personnel resources

- clear and regular communication between Government and contractor Lab personnel regarding Lab priorities, work assignments, and allocation of personnel resources

- a clear definition of what is expected when a work assignment is given

- regular status reporting and accountability for the completion of work assignments, and

- an organizational structure that will alleviate some of the management problems the Lab has experienced. Below, we have presented several possible organizational structures.

Alternative Organizational/Management Structures:

1. Designate one of the 3 key Government personnel as Lab Manager. This person would coordinate all aspects of Lab operations:

    - budget and funding
    - regular communication sessions ("staff meetings") involving all contractor and Government personnel
    - staffing
    - work assignments and workload
    - etc.

2. Form permanent teams led by each of the key Government personnel, and staffed with contractor personnel. In addition, the Government personnel would form a coordinating team to coordinate all aspects of Lab operations (see above).

3. Form two teams, a coordinating team made up of the key Government personnel and a self-directed work team of contractor personnel. A self-directed work team is one in which team leadership and management is provided from within the team itself. As in #2 above, the Government coordinating team would coordinate all aspects of the Lab operation. The contractor self-directed work team would serve as a resource pool out of which temporary teams would be formed to meet a specific need (project, study, etc.) and disbanded when the need is satisfied. See Figure 6.3 for a diagram of this fluid organizational structure.

4. Appoint a contractor team member to act as "Lab Manager." This role would involve coordinating priorities, work assignments, resource allocation, and schedules between key Government Lab personnel and the contractor staff pool, and ensuring that regular communication sessions are held involving Government and contractor personnel.

Any of the above will work, but the key is discipline. Government Lab personnel must coordinate with each other regarding direction, priorities and resource allocation, and then must communicate with the contractor resource pool to staff projects, surveys, or tasks. However, we recommend that the Lab adopt option #3. Our assessment is that this structure would be best suited to the nature of the project work undertaken by the Lab and the personalities of the key Government personnel.

<u>Summary Recommendations</u>

Below we have summarized our major recommendations and conclusions, and listed them in the order of importance.

1. Introduce improvements in the Lab management/organizational structure.

2. Prepare criteria to guide the selection of a development environment. Evaluate, select, and acquire the development environment based on those criteria.

3. Develop plans for the migration from the VAX computing platform, based on the development environment.

4. Evaluate, select, and acquire statistical analysis software consistent with the development environment and the migration plans.

5. Execute the VAX migration plans to position the Lab for the loss of the VAX platform.

6. Complete the planning steps for goal accomplishment proposed in the Function/Goals Matrix document.

7. Using the newly acquired development environment, carry data and process analysis and design for the integrated CARD Lab Data System to the next level of detail.

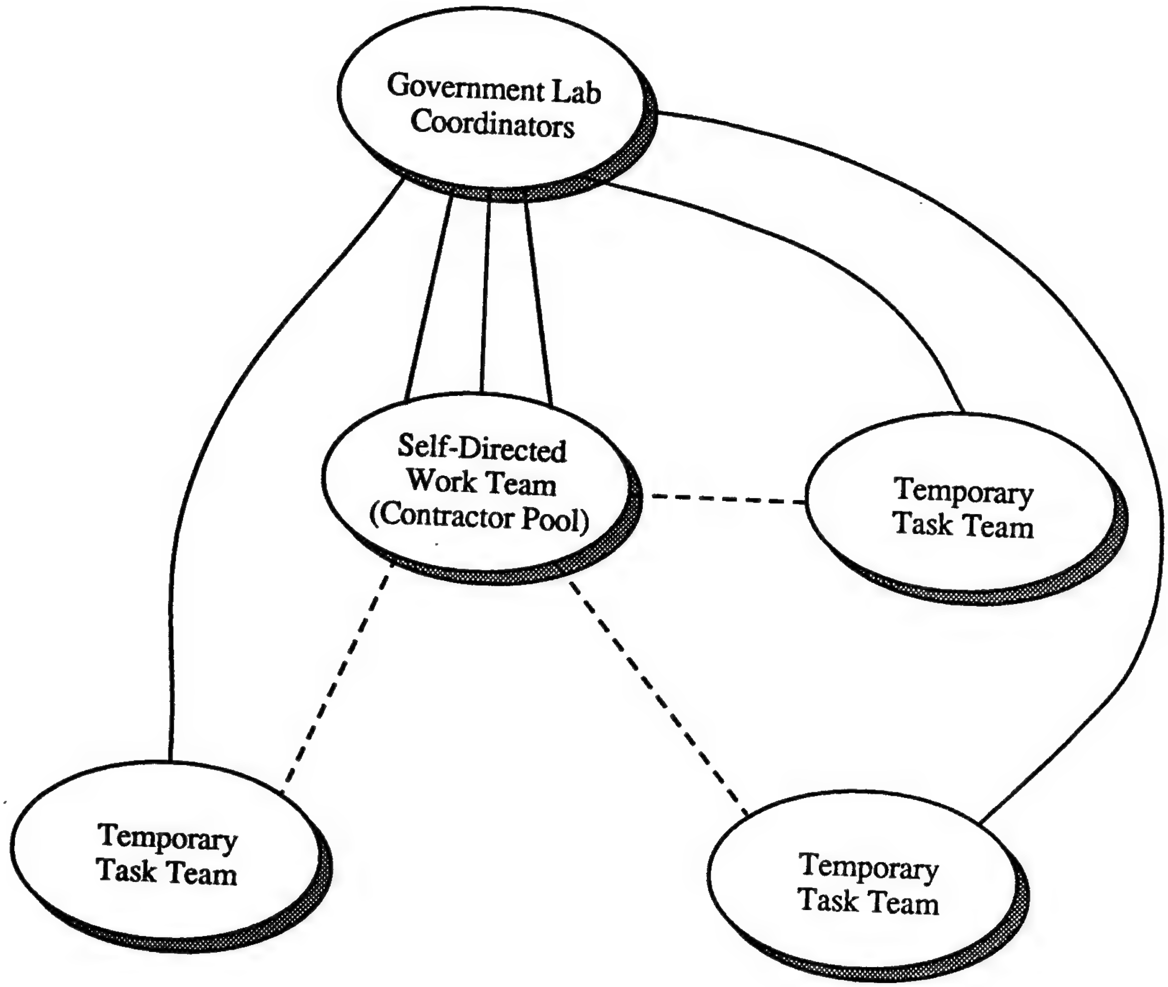

FIGURE 6.3

Lab Organizational Structure

Database Modification and Maintenance

ASCC

During this reporting period the female ASCC report was put on hold due to funding considerations. The current female ASCC report resides on FALCON in the directory ANTHRO$DISK:[ANTHRODATA.TAPE.FEM]. This report was in LATEX format. Files in this directory include RIM database files which contain data for those surveys to be included in the report. Software to extract data from the RIM database and to format the data for LATEX reside in the files ASCC.FOR and SURVEY_STATS.FOR.

Cockpit Accommodation Database

Four tasks were identified in support of this project. These included completion of the CADB on the FALCON VAX, development of procedures for CADB use, and the rehosting of the CADB to a UNIX DBMS. Each of these tasks and their status will be discussed.

Overview

The CADB software currently on the FALCON VAX resides in the directory ANTHRO$DISK:[ANTHRODATA.ACCOMDB]. Files in this directory and its subdirectories are identified as follows:

Directory ANTHRO$DISK:[ANTHRODATA.ACCOMDB]

CACCOM1.DAT CACCOM2.DAT CACCOM3.DAT	These files are the MASTER RIM files for the CADB. The database name is CACCOM and the password is COCKPIT. Updates should be made to these files and new copies of these files transferred to where they are needed.
CACCOM1.SAV0393 CACCOM2.SAV0393 CACCOM3.SAV0393	These are the backup files for the CACCOM saved in March of 1993.
CACCOM1.NEW CACCOM2.NEW CACCOM3.NEW	These RIM files contain modifications to the VISION relation.
SCHEMA.DAT;1	CADB database SCHEMA

Directory ANTHRO$DISK:[ANTHRODATA.ACCOMDB.INFORMIX]

This directory contains backup files for the CADB residing on the UNIX system in the CCCD lab. It is mostly here for archiving and for printing purposes.

Directory ANTHRO$DISK:[ANTHRODATA.ACCOMDB.RIMDAT]

These files are the input files to the CACCOM database. These files are input into the database using the RIM LOAD and INPUT commands. Each file represents data for the associated relation.

Directory ANTHRO$DISK:[ANTHRODATA.ACCOMDB.SASREG]

These are the SAS procedures used to produce the regression constants and coefficients entered into the database.

Directory ANTHRO$DISK:[ANTHRODATA.ACCOMDB.SOURCE]

This directory contains the source code for the CADB applications interface program ACCOM. The RIM database is accessed using RIM FORTRAN interface routines. The user interface uses the VAX Screen Management (SMG) routine interface. This directory also contains a copy of the CACCOM RIM database file for software testing purposes.

ACCLIB.OLB	The FORTRAN library containing ACCOM subroutines
ACCOM.COM	Command file to compile and link ACCOM
ACCOM.EXE	ACCOM executable
ACCOM.FOR	ACCOM FORTRAN source code
AIRBLK.FOR	ACCOM "include" common block file
AIRCRAFT_DATA.FOR	Routines which retrieve data from database.
BLDALIB.COM	Command file which builds ACCOM subroutine library.
C141_DESC.TEXT	C-141 description text file.
C141_SEATADJ.FOR	C-141 seat adjustment routine.
CACCOM1.DAT CACCOM2.DAT CACCOM3.DAT	Local copy of CACCOM RIM database for testing
CHGCODE.COM	Command file for updating subroutine in ACCOM library
CLEARANCE.FOR	Clearance subroutines
COCKPIT_WELCOME1.TEXT COCKPIT_WELCOME2.TEXT COCKPIT_WELCOME3.TEXT	CADB program introduction text.
CONTROL_DATA.FOR	Subroutines to process control data information
CONVERT.FOR	Conversion routines
DBACOM.FOR	Database application "include" common block file
DESC.FOR	Subroutines for aircraft description
F16_DESC.TEXT	F-16 description text
F16_SEATADJ.FOR	F-16 seat adjustment routine
HEADING.TEXT	Subroutines to handle heading screens
LIST.FOR	Subroutines to list aircraft categories
QRYLIB.OLB	Database application routine library
REACH.FOR	Subroutines handling reach data

SEAT.FOR	Subroutines handling seat options
SELECT_AIRCRAFT.FOR	Subroutines handling aircraft selections
SELECT_OPTIONS.FOR	Subroutines handling menu options
T1A_DESC.TEXT	T-1A description text
T1A_SEATADJ.FOR	T-1A seat adjustment routine
T37_DESC.TEXT	T-37 description text
T37_SEATADJ.FOR	T-37 seat adjustment routine
T38_DESC.TEXT	T-38 description text
T38_SEATADJ.FOR	T-38 seat adjustment routine
VISION.FOR	Vision subroutines

The CADB software being written on the Silicon Graphics Platforms reside in:

SG 4D/25 machine: nuthatch

Directory: /usr/people1/kevin/db

X-window Graphical User Interface (GUI)

Directory: /usr/people1/joyce/informix

INFORMIX cockpit database input files

Directory: /usr/people1/joyce/informix/code

Applications interface routines for the CADB

SG 4D/440 machine: v1sg16 (in CCCD laboratory)

user: card
password: cockpit1

The database files are stored in the dbspace designated by CCCD. These files may be accessed by using isql and requesting the database name cockpit. Default directory for user card is /dvp/people/card.

Completion of the CADB

Validation of database algorithms for the F-16A and C-141A:

We have found that this task is an ongoing task as new relationships of the data are identified through further analysis of the cockpit accommodation data. We are aware that organization of these data into an electronic database was not a consideration when data were collected. Often this has resulted in incomplete data for an aircraft. Although relationships between data types were identified and a database schema derived, we have found that due to the nature of the data it is often difficult to analyze the data routinely across all aircraft. For example, although description of seat adjustment parameters across all aircraft can be standardized, the actual positioning of the seat for each of the

subjects is aircraft specific. In this case, the need to code separate algorithms for each aircraft was a necessity although the actual seat adjustment parameters are retrieved from the database.

Existing database algorithms have been verified although these algorithms have also been updated since that time. Again additional analysis of the data identified the need to add an additional parameter into the VISION relation. This new parameter was added to a working copy of the database stored in ANTHRO$DISK:[ANTHRODATA.ACCOMDB] in the files CACCOM1.NEW, CACCOM2.NEW, and CACCOM3.NEW. Updates to the vision algorithm to accommodate new parameters in the relation VISION have not been incorporated.

Entry of TRAINING A/C Measurements Into the Database:

Additional data have been entered into the database including the T-37B, T-38A, and T-1A data. Seat adjustment algorithms were also coded and incorporated into the database to accommodate the addition of these training aircraft.

Development of Procedures for CADB Use

The procedure for obtaining and analyzing cockpit accommodation data will be accessible through the rehosted database on the Silicon Graphics (SG) workstation. Currently a technical report is being reviewed which contains the procedures for the cockpit measurements taken. Upon completion of this report, the text will be electronically transferred to the SG and incorporated into the CADB. The Graphical User Interface (GUI) has been coded to allow for the insertion and access of this text on the SG. In addition to procedures text, allowance has been made to display an associated photograph to assist in the description of the measurement taken. These photographs need to be scanned into the Macintosh computer and transferred in GIF format on the SG.

PORT the CADB to a UNIX (SG Iris-Compatible) DBMS

Port the data to the new database:

The data from the existing CADB RIM database has been ported to the INFORMIX database resident on the CCCD SG 4D/440 workstation (v1sg16). This includes the schema definition (Appendix F) and the actual data from the RIM database as shown in Appendix F. Data was unloaded from the RIM database, reformatted into a command file, and loaded directly into the INFORMIX database using the file CPLOAD.COM as shown in Appendix F. The INFORMIX dbload command was used to accomplish the load. The INFORMIX database schema is shown in Appendix F. This schema was loaded into the database using the dbimport command. The data files used reside on the SG4D/440 in the directory /dvp/people/card.

Develop a user interface compatible with the CDS:

The Graphical User Interface (GUI) was developed using X-windows on the SG workstation. Currently this software resides on the 4D/25 (nuthatch) located in the CARD laboratory. This interface consists primarily of windows and menus which guide the user in selection of data from the database.

Currently the algorithms necessary for data reporting have not been coded. Routines to extract commonly requested data from the database into memory have been rehosted. Seat adjustment algorithms have also been coded but not yet compiled and tested. Database interface routines are included in Appendix E. While common variables to allow the GUI and the applications have been identified, the integration of these two subsystems has not been accomplished.

The following describes the location and functionality of the source code files, as well as an explanation of how the new Cockpit Accommodation Database interface works.

All source files used to create the GUI are found on nuthatch under the /usr/people/kevin/db directory. These source files are compiled to create the GUI using the makefile found in that same directory. They are found in Appendix F.

buildmenu.c is used to build popup, option, pulldown, and pullright menus, which are defined by declaring an array of menu item structures.

popupclearancemenue.c is used to pop up the overhead clearance menu.

setwidgetcolorscheme.c is used to set the color attributes of a given widget.

dataentry.c is used to create and manage the data entry screen, and pass information to the database querying code.

popupdataselection.c is used to pop up the data menu when the data button on the data entry screen is pressed.

displaypicture.c is used to display pictures when information is requested while processing the data button on the data entry screen.

displaytechinfo.c is used to display technical information about a selected data subject.

generatorport.c is used to create, display, and print report listings.

infowindow.c is used to contain textual information about a selected subject.

motifl.c is the main module of the GUI, and processes inputs to the main menu.

readtextfile.c is used to read textual information from technical data found in the textdesc subdirectory.

reportwindow.c is used to contain textual information of a report, and allows one to print the report to a hardcopy printer.

updateclearanceselection.c is used to update the current clearance selection.

utils.c is a collection of utility routines to destroy or find various widgets.

dataentry.h contains definitions used to drive the data entry screen.

typedefs.h contains various special types definitions.

menu.h contains menu structures used by the GUI.

constants.h contains definitions of constants used throughout the GUI.

The Database Introduction window is an information window created by infowindow.c. It is scrollable and is dismissed by clicking the left mouse button on the OK button.

The Survey Description display consists of three windows: a selection window, an information window, and a picture window (see Figures 6.4 through 6.6). To display information about an aircraft survey, one simply selects an aircraft from the selection window, and an information window as well as a picture window will be displayed.

The Data Entry window is used to gather data from the user for the Individual Body Type Fit Analysis. In this window the user enters various individual measurement data describing the Thumbtip Reach, Shoulder Height, Knee Height, Buttock-Knee Length, Sitting Height, and Eye Height. The user then selects an Aircraft, Crewstation, and either enters or has the computer compute the proper seat position based on the data entered. Once this data is entered, the user may select the Data button, and choose to view a variety of reports from a cascading menu. To dismiss this window, the user clicks the mouse on the Exit button.

<u>Data Input Program</u>

In order to facilitate analysis of accommodation data collected in the field, an effort has begun to automate input of data and formatting of that data for analysis using statistical packages such as SAS. A software program was written which allows for the input of raw reach data collected in the field. Actual field data for accommodation analysis of the T-38A aircraft was entered using this program.

This program was coded in FORTRAN. This prototype which resides on the VAX will ultimately be transferred to an MS/DOS personal computer which will allow for input of data in the field. This will eliminate the requirement to transfer data from handwritten data sheets to an electronic data format.

Program CINPUT allows input of both aircraft data and subject reach data. Aircraft data specifications must be entered first as this determines the information to be entered for each subject. Aircraft data includes input of aircraft crewstations, seat adjustment specifications, and reach control descriptions. Once the aircraft data is entered, subject data may be entered. The user will be prompted for each control by hand and by zone.

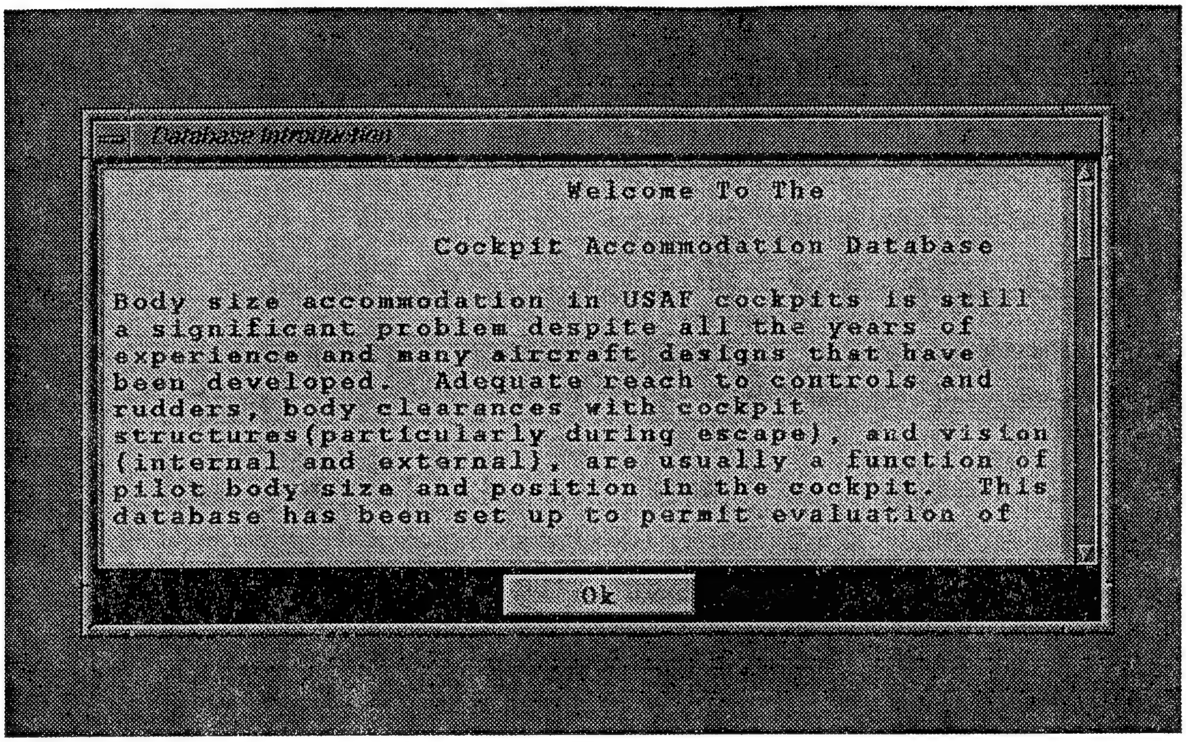

FIGURE 6.4

Selection Window

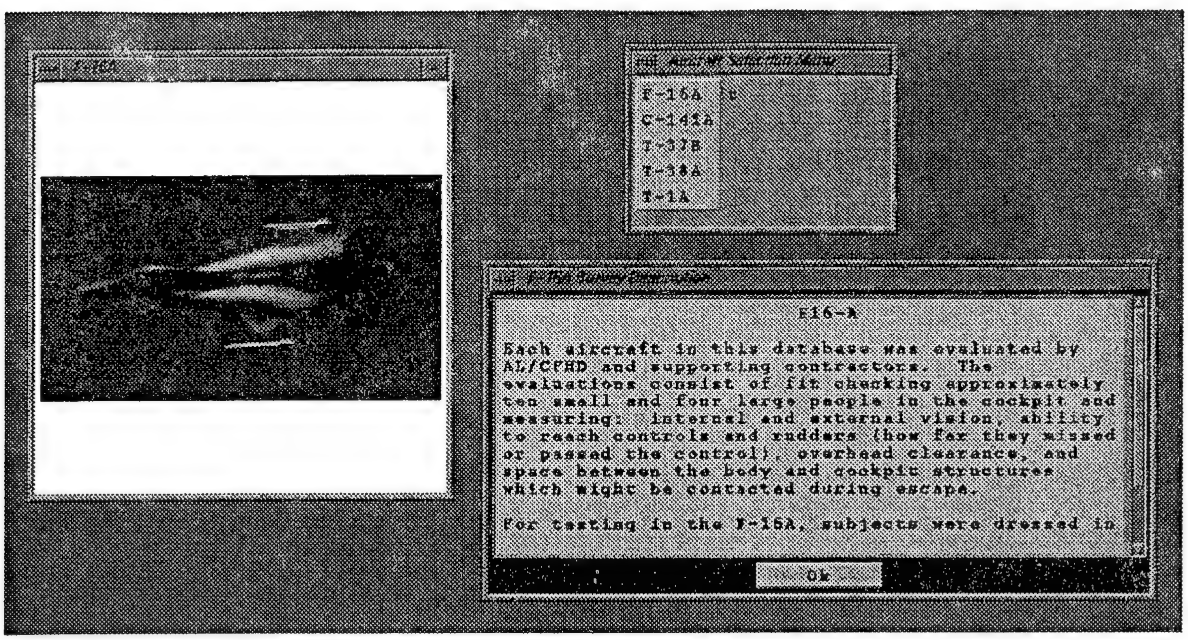

FIGURE 6.5

Information Window

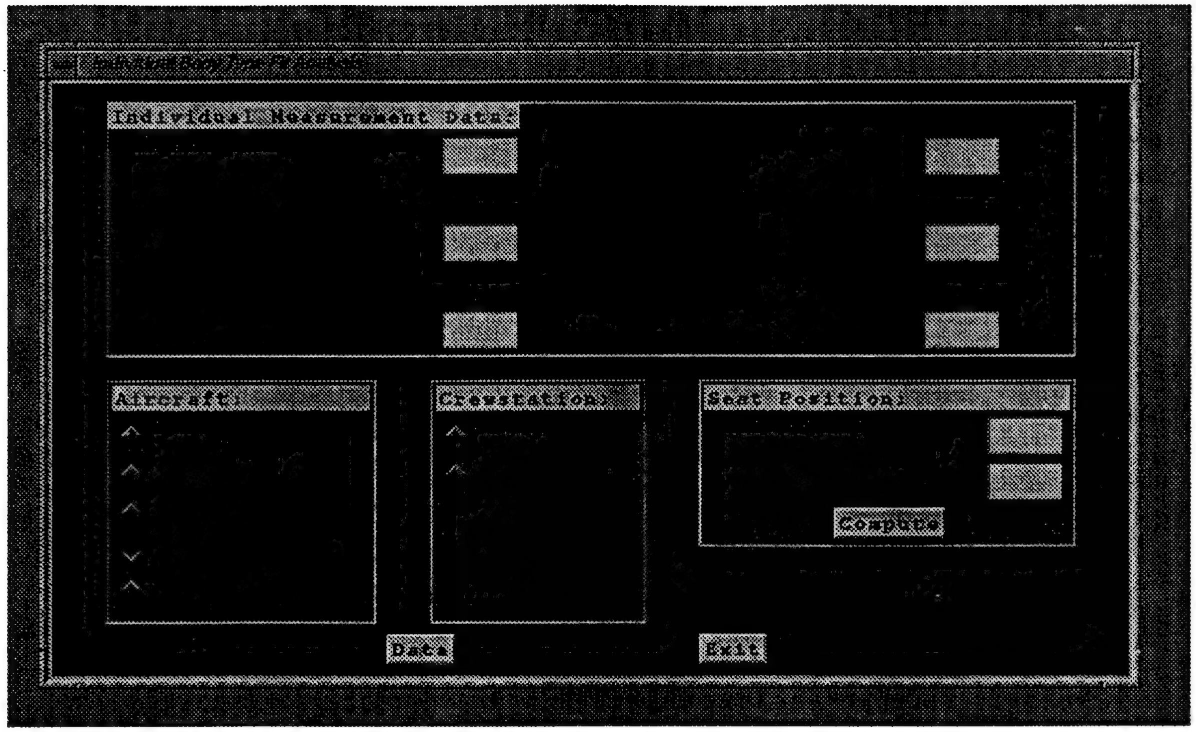

FIGURE 6.6

Picture Window

Code for CINPUT resides in the FALCON directory ANTHRO$DISK: [ANTHRODATA.KEN]. Currently data for the T-38A aircraft also resides in this directory. The file T-38A.DAT contains aircraft specific data, and SUBJECT.T-38A contains subject raw data. A program listing and excerpts from the data files appear in Appendix G. A sample script for data input is also given in Appendix G.

T-38 Data

The T38 data is currently being reanalyzed. Those conducting the analysis have requested that a set of SAS and Fortran Procedures be developed that will enable them to do the analysis without assistance. In order to better understand the needs of the analysts, a set of procedures outlining the perceived analysis methodology were written and distributed to them. They also detailed the data and format currently needed to create regression coefficients using SAS for the cockpit database. These procedures are given below:

1. Gather data. Data records should be entered on disk in the following format:

   SBJNUM CONT POS SIDE HAND ZONE SHLDRHT TTREACH

   where SBJNUM is the subject number,
   CONT is the instrument control number,
   POS is 'FU' for Full-up,
   SIDE is either 'FC' for forward cockpit or 'AC' for aft cockpit,
   HAND is either 'LH' for left hand or 'RH' for right hand,
   ZONE is either 'Z1' for Zone 1 or 'Z2' for Zone 2,
   SHLDRHT is the shoulder height sitting in inches,
   TTREACH is the thumb tip reach to the control in inches.

   There should be for data files: 1) forward cockpit, left hand; 2) forward cockpit, right hand; 3) aft cockpit, left hand; 4) aft cockpit, right hand. Suggested names for these files are NFCLH38.DAT, NFCRH38.DAT, NACLH38.DAT, and NACRH38.DAT.

2. Edit and run a SAS procedure for each of the data files to get the data in SAS format. Suggested names for the new SAS datasets are NFCLH38, NFCRH38, NACLH38, and NACRH38. (These files will automatically be given the extension .SASEB$DATA.) (See [anthrodata.crewstation.t38]create.sas).

3. Edit and run FL38REG.SAS, FR38REG.SAS, AL38REG.SAS, OR AR38REG.SAS to get predicted thumb tip reaches for test data based on existing T38 data. (Test data refers to the data that will be used to compare the existing T38 data to the new T38 data.)

4. Edit and run NFL38REG.SAS, NFR38REG.SAS, NAL38REG.SAS, and NAR38REG.SAS to get predicted thumb tip reaches for test data based on the new T38 data.

VAX Conversion Status

There is a possibility that the CARD database and SAS processing will be migrated to the CCCD VaxStation III/GPX. Previously the CCCD lab was operating two VaxStations, the III/GPX and a II/GPX. During this report period software from the II/GPX was migrated to the III/GPX. AL/CFHD is exploring the possibility of obtaining SAS for one of the VAX workstations and porting RIM to the same allowing for the porting of the CARD 2D database on one of these VaxStations. In order to determine the feasibility of the rehost, several factors will need to be studied including memory and storage requirements, cost factors, user accessibility and software compatibility. It is important to note, especially when determining third party software requirements, that the VaxStation III/GPX is a VaxStation 3100 CPU in the VaxStation II enclosure. This distinction will need to be made to any third party vendors to ensure software/hardware compatibility.

TASK 7 ...shall perform cockpit and workstation body size accommodation analyses. This includes determining the minimum and maximum values of reach and clearance for safe operation and escape at each crew station, as well as quantification of the visual field...This shall include methodology, anthropometric measures to be taken, and a questionnaire directed at users of each crew station.

Accommodation Analysis

The final draft of an Air Force technical report entitled "Anthropometric Accommodation in Aircraft Cockpits: A Methodology for Examination" was completed during this past reporting period and is submitted under separate cover. Some additional work was done on expanding an outline of a plan to extend the cockpit accommodation effort to the remaining USAF inventory aircraft; this will require considerably more work, however, to become a full-scale proposal.

Re-Analysis of the T-38

At the request of the USAF, Dr. Kennedy travelled to Randolph Air Force Base, San Antonio, Texas to participate in a follow-on examination of the anthropometric accommodation offered in the cockpits of the T-38A aircraft. Travel was commenced on Sunday, 13 June and completed on Thursday, 17 June 1993. Mr. G. Zehner, 2d Lt J. Helfter, and 2d Lt G. Bailey participated in the evaluation. The following examinations were performed:

1. Overhead Clearance: 5 subjects
2. Operational Leg Clearance: 3 subjects
3. Ejection Clearances: 3 subjects
4. Rudder Pedal Operation: 9 subjects
5. Vision: 13 subjects
6. Hand Reach To and Actuation of Controls: 5 subjects

Evaluation of Computer Models

The final draft of a report entitled "Validating Computerized Human Analogues Used to Predict Cockpit Accommodation" was completed and appears here as Appendix I. This study, which made use of empirical accommodation data collected in an evaluation of the F-16A, was originally intended as a means of validating the COMBIMAN model. Very little actual COMBIMAN data was made available, however (beyond a series of Zone 2 reaches for the left hand to 13 controls on the main instrument panel of the F-16A). Thus, the report serves in part as an outline which can be used for this purpose if desired, and in part as the basis for developing a USAF Technical Report describing techniques for validating computer man models.

U.S. Navy Cockpit Accommodation Guide

At the request of Mr. Zehner, Dr. Kennedy reviewed a report entitled, "Procedural Guide to Aircrew Anthropometric Accommodation Assessment," by Scott A. Price, Systems Engineering Test Directorate, Naval Warfare Center, Patuxent River NAS. A copy of the review appears as Attachment 7.1.

Miscellaneous

A SAS program was written at the request of Mr. Zehner to compute regression equations using the ANSUR data to predict selected anthropometry from weight, sitting height, and leg length (derived from the summation of buttock-knee-length-buttplate and knee-height-sitting). The program also outputs predicted values plus and minus two standard errors for user-input dimensions. This program is given below:

```
LIBNAME HOME "HEG$DISK:[GZEHNER]";
OPTIONS LINESIZE=75;
DATA QUERYSET;
  SET HOME.ARW88WT
  (KEEP= M529 M195 M758 M805 M957 M122 M236 M230 M459 M378 M921 M852 M856
  M678 M751 M375 M25 M330 M1057);
  IF (M1057 GE 31);
  LEGG=M195 + M529;
  LABEL M195="BUTTOCK-KNEE-LTH-BUTTPLATE";
  LABEL M758="SITTING-HT";
  LABEL M805="STATURE";
  LABEL M957="WEIGHT";
  LABEL M122="SHOULDER-BRDTH";
  LABEL M236="CHEST-DEPTH";
  LABEL M459="HIP-BRDTH-SIT";
  LABEL M751="SHOULDER-ELBOW-LTH";
  LABEL M375="FOREARM-HAND-LTH";
```

```
 LABEL M529="KNEE-HT-SIT";
 LABEL M852="THIGH-CIRC";
 LABEL M921="WAIST-CIRC";
 LABEL M856="THIGH-CLEARANCE";
 LABEL M678="POPLITEAL-HT";
 LABEL M1057="RANK";
DATA NEW;
 INPUT M758 LEGG M957;
CARDS;
32.8 40.0 103.0
32.8 40.0 138.0
31.0 38.9 92.0
31.0 38.9 136.0
34.9 49.8 131.0
34.9 49.8 205.0
40.0 52.1 151.0
40.0 52.1 245.0
38.0 52.7 151.0
38.0 52.7 245.0
38.5 43.3 123.0
38.5 43.3 194.0
;
DATA ALL;
 SET QUERYSET NEW;
%MACRO REDO(predict,dataset,yhat,mse,low,high);
PROC REG OUTEST=EST;
 MODEL &predict=M957 M758 LEGG;
 OUTPUT OUT=STATS P=&yhat;
DATA &dataset;
 SET STATS(FIRSTOBS=200);
 KEEP M758 LEGG M957 &yhat _MSE_;
 &mse=_MSE_
 &low=&yhat-_MSE_;
 &high=&yhat+_MSE_;
RUN;
%MEND REDO;
DATA MERGE;
 MERGE TEMP1 TEMP2 TEMP3 TEMP4 TEMP5 TEMP6 TEMP7 TEMP8 TEMP9 TEMP10
TEMP11;
PROC PRINT;
RUN;


%REDO(M378,TEMP1,YHAT1,MSE1,LOW1,HIGH1)
%REDO(M122,TEMP2,YHAT2,MSE2,LOW2,HIGH2)
```

```
%REDO(M459,TEMP3,YHAT3,MSE3,LOW3,HIGH3)
%REDO(M230,TEMP4,YHAT4,MSE4,LOW4,HIGH4)
%REDO(M236,TEMP5,YHAT5,MSE5,LOW5,HIGH5)
%REDO(M921,TEMP6,YHAT6,MSE6,LOW6,HIGH6)
%REDO(M852,TEMP7,YHAT7,MSE7,LOW7,HIGH7)
%REDO(M856,TEMP8,YHAT8,MSE8,LOW8,HIGH8)
%REDO(M678,TEMP9,YHAT9,MSE9,LOW9,HIGH9)
%REDO(M751,TEMP10,YHAT10,MSE10,LOW10,HIGH10)
%REDO(M375,TEMP11,YHAT11,MSE11,LOW11,HIGH11)
```

ATTACHMENT 7.1

TM 92-74 SY, "Procedural Guide to Aircrew Anthropometric Accommodation Assessment," (DRAFT) by Scott A. Price, Systems Engineering Test Directorate, Naval Warfare Center - Aircraft Division, Patuxent River NAS, MD, 20670, 13 October 1992.

Reviewed by: Kenneth W. Kennedy, Ph.D.
Consultant in Engineering Anthropometry
1420 Meadow Lane
Yellow Springs, OH 45387

The most puzzling characteristic of this document is that the body of the report does not contain as much information regarding technique as does Appendix I, "Quick Reference/Summary of Procedures." For that reason, the review of procedures is divided into three parts, TEXT, QUICK REF, and COMMENT; for information taken from the body of the report, from "Quick Reference/Summary of Procedures," and commentary regarding the appropriateness and usefulness of the procedures.

While this report is quite well written and informative, it does not show signs of having the benefit of broad experience: there are no nuances of procedure or recommendations that reveal themselves to be the results of experience in the aircraft cockpit, even though the author indicates that these procedures are the result of research and field testing experience originally conducted for NAVAIRSYSCOM and the T-45A program. All information could easily have been developed at the desk through reflection and by consulting with other personnel and reports.

The Test Center was tasked by NAVAIRSYSCOM to "develop new procedures for determining the ranges and limitations of anthropometric accommodation in military aircraft" in an operational environment. It is intended to enable the "establishment of Anthropometric Restriction Codes" to reduce the need for "fit checks, guide Student Naval Aviators into appropriate pipelines, determine contractor compliance, identify deficiencies in the crewstation layout of mockups and aircraft undergoing development." It is intended to be a stand alone procedure that can be performed without reference to requirements so that requirements do not "interfere."

NAVAIRSYSCOM no longer endorses the use of most Mil Stds to provide guidance in anthropometric accommodation. However, appendices to this report consist of summaries of Mil Stds 203G (Aircrewstation Controls and Displays: Location, Arrangement and Actuation of, for Fixed Wing Aircraft), 250D (Aircrewstation Controls and Displays for Rotary Wing Aircraft), 850B (Aircrewstation Vision Requirements for Military

Aircraft, 1333B (Aircrewstation Geometry for Military Aircraft), 1472D (Human Engineering Design Criteria for Military Systems, Equipment and Facilities) Mil-H-46855B (Human Engineering Requirements for Military Systems, Equipment and Facilities), Mil-C-81774A (Control Panel, Aircraft, General Requirements for). Data forms are also contained in Appendices.

Subject selection criteria is expressed in terms of percentiles, i.e., 5th and 95th percentile Naval Aviators. Crew members are considered optimum subjects. Recommends looking for close matches to desired anthropometric dimensions, although the values for these dimensions are not specified. Extremes should be sought, i.e., short/thin, short/heavy, tall/thin and tall/heavy - a minimum of four subjects. If time permits, another small and large subject should be added. If one or two more are allowable, they should represent the middle range of the population. Subjects in excess of eight should be spread throughout the range. Although Sitting Shoulder Height is recognized, almost as an afterthought, as second only to Functional Arm Reach to the understanding of reach capability, individuals on the high side for Sitting Shoulder Height, relative to their Sitting Eye Height, are not acknowledged as most appropriate subjects.

The report indicates that current methods of measurement differ from those used in the "outdated" Anthropometric Survey of Naval Aviators - 1964, as well as those used by other military services, contractors, and foreign studies. It is not reported how or why they differ nor is there a specific reference to an alternative source. If techniques and data differ, percent accommodation should be very difficult or impossible to acquire.

Anthropometric dimensions considered important consist of the following:

Sex	Functional Arm Reach
Age	Hand
Race	Functional Leg Length
Stature	Buttock-Knee Length
Weight	Sitting Knee Height
Sitting Height	Bideltoid Breadth
Sitting Eye Height	Sitting Hip Breadth
Sitting Acromial Height	Thigh Circumference
Boot Size	Lower Thigh Circumference

Blocking to a maximum of one inch is proposed for use in the measurement of overhead clearance, external and internal fields of view, functional arm reach, functional leg reach, leg clearance, and ejection clearance - in other words, all of them. The author proposes the use of Space Vector, a 3-D point location device to track relocation of body landmarks as a result of blocking. Primary areas for blocking are under boot and buttocks and behind lower back. Boot and butt blocks that are shaped to fit (the boot or the pedals?) are proposed. The author expresses caution in adjusting seat to simulate large and smaller body dimensions.

Proposes locating NSRP and SRPs for full up, full down, full forward, and full aft with regard to other aircraft hard points "to allow comparison against cockpit/crewstation design/specifications, aircraft configuration changes, and future AAAA test sessions." SRPs are, therefore, interpreted as hard points, which appears to go against previous USN policy. NSRP is determined from contractor diagrams and descriptions. USAF experience, when considering NSRP and SRPs as hard points has been less than satisfactory.

Proposes detailed statistical analysis "if sufficient number of subjects and data points are available." Cites use of Minitab, SAS, SPSS, STATA, and Systat for large amounts of data. Proposing these high powered statistical packages seems like overkill to me.

OVERHEAD CLEARANCE

TEXT: Clearance above and to the sides of the head are measured.

QUICK REF: Clearance evaluation includes tilting the head left and right to increase over-the-nose and over-the-side external fields of view: twisting the torso, neck, and head around for aft field of view.

Measurements performed at multiple seat positions and with blocking.

COMMENT: These procedures suffer from indecision with regard to purpose. Are they for determining if a given subject is accommodated in a cockpit or to measure the maximum Sitting Height that can be accommodated? Measurement is made at different seat adjustments so one is led to believe that maximum accommodation is sought. However, since the inclusion of the amount of additional downward seat adjustment is never considered in such determinations, there is some uncertainty. But why measure in different seat positions, beginning with, i.e., full down?

There are no specific instructions to measure parallel to ejection rails or seat adjustment line.

I question the usefulness of blocking when measuring Overhead Clearance.

EXTERNAL FIELD OF VIEW

TEXT: Proposes to measure vertical limits of lines-of-sight straight ahead (zero azimuth) and at selected, although not specified here, angles left (port) and right (starboard). Uses an "optical protractor" to attain selected azimuths. Field of View Evaluation Apparatus (FOVEA), which is controlled remotely, provides detailed azimuth and elevation "maps" of external field of view from DEP or alternative eye positions.

QUICK REF: Begin with seat full down and, as appropriate, aft. Consider various head positions for external field of view, flight demands, and use of controls. For example, head in Frankfort Plane, tilted to left and right, and bending body to left and/or right for over-the-side external view and take external field of view elevation measurements at selected azimuths.

Azimuths include straight ahead (0 degrees), 20-30 degrees right and left, over-the-side right and left, aft right and left.

Repeat measurements with blocking and at predefined seat positions.

COMMENT: Many of the same comments regarding Overhead Clearance apply here as well, especially those having to do with purpose and blocking. There are no recommendations regarding the "predefined" seat positions that are called out or defining the location of the eyes in alternative head positions.

INTERNAL FIELD OF VIEW

TEXT: Includes visual access to HUD - the sight bundle or "porthole." NAVSYSCOM appears to have developed the capability to define "Instantaneous Field of View, Total Field of View, and Biocular Instantaneous Field of View" using a photographic process. Obstructions to vision are also diagrammed. See paragraph 109.

QUICK REF: Drawings of the display panels are shaded to define areas of obstruction. Begin with seat full down. Use different head positions and tilts representative of aircrew needs, flight demands, access to HUD, and use of crewstation controls. Same head, neck and torso movements are allowed as for External Field of View. Note each instrument, display, and control, the percentage of its useful surface area obstructed, etc. 3-D coordinates of eye are determined during fore and aft motion of the head to access the full display offered by the HUD. Repeat with blocking and seat positions.

COMMENT: Same as for External Field of View.

FUNCTIONAL ARM REACH

TEXT: Acknowledges importance of Thumb-Tip (Functional) Reach and Sitting Shoulder Height. Dimensions of secondary concern are Downward Vertical Reach, Upward Vertical Reach, Bideltoid Diameter, Shoulder Elbow Length, and Hand Length. Since this is a general procedures document, i.e., including application to helicopters and larger flight decks, it acknowledges that overhead controls favor higher shoulders. Also acknowledges that controls to the right of the centerline of the main instrument panel may have to, on occasion, be reached by the left hand. The attempt is made to derive the percent of total excursion of controls with large ranges of motion, i.e., throttle and control stick,

possible with "X" value for Thumb-Tip Reach - also that full excursion of such controls may never be used. There may be a point beyond which there is not additional effect. How this is determined is not discussed.

When measuring miss distances, a measurement is made from the interface point on the control to the appropriate interface point on the hand. They also attempt to measure surplus reach distances, although in most cases we have found this to be difficult to impossible since the hand would typically have to be pushed through the plane of the instrument panel. In an apparent contradiction to these instructions, the author proposes that "Surplus distances, as well as miss distances, are measured from a specified area on the forearm . . ." - a reference band about five inches above the wrist. He also proposes the alternative of premeasuring the distances from the "reference band" on the forearm to the interface points on the hand. I get the impression that the latter procedure is used only when there is surplus reach capability. Does not appear to really use the reach subject as a "tool" for calculating Equivalent Thumb-Tip Reaches.

Reach is evaluated using three undefined seat positions.

QUICK REF: Functional reach testing determines the degree to which a person can properly, efficiently, and comfortably reach and actuate a hand control. Acknowledges worst case combination of small Thumb-Tip Reach and relatively large Sitting Shoulder Height.

The author proposes using drawings of the instrument panels to "make notes and shade in obstructed areas." The initial seat position is full down. Zones 1, 2 and 3 measurements are made as described in Mil Std 1333. Miss distances are measured between the interface points on the hand and control. Surplus reaches are measured from the reference band around the lower forearm - apparently as USAF does it.

Additional seat positions and blocking are used.

COMMENT: We found that measuring to the actual interface point on the hand in the cockpit when reaching toward a control was physically difficult, subject to paralax error, and uncertain as to accuracy of palpation. The latter is especially true with regard to the grip and hook. The author appears to propose USAF techniques only when measuring excess reach capability.

There is no discussion of data analysis so whether or not the author proposes to calculate a minimum Thumb-Tip Reach to access a given control is uncertain. Even though Mil Std 1333 definition of reach Zone 3 is included in the discussion, a technique for measuring it is not.

FUNCTIONAL LEG LENGTH

TEXT: Anthropometric dimensions include Functional Leg Length, Buttock-Knee Length, Sitting Knee Height, and Boot Size.

Does not describe foot-boot contact with pedals, although miss distances are measured from the pedal to the center of the heel. Seems to confuse purpose of measuring pedal access with acceptability of subject and the minimum length of leg that can operate pedals. Appears not to be most concerned with the latter.

QUICK REF: Although acknowledges that leg reach is usually a concern for smaller subjects, the proposed starting seat position is full down and aft and pedal carriage full aft. Miss distances are measured from the "underside" of the boot (footwear) to the interface point on the foot control. Reference is made to "surplus" distances, but I am uncertain if this term applies to the subject having additional reach capability or if the pedal can be pushed farther forward.

Procedures are repeated at "additional," but undefined seat positions and with blocking.

COMMENT: Some uncertainty regarding purpose of measuring. Is it to evaluate a specific subjects accommodation, or to measure minimum population accommodation? How "predetermined" seat positions are established is not described.

LEG CLEARANCE

TEXT: Procedures pretty much parallel those of USAF, except that optimum seat and rudder carriage positions are only conditions under which clearance with cockpit structure is observed and measured. Blocking for Butt-Knee and Knee Height is proposed, but would appear to be used only in the subject's chosen seat/rudder positions.

QUICK REF: Primary body dimensions are "functional leg length, buttock-leg length, sitting knee height, boot size, thigh circumference, and lower thigh circumference." Measurements are taken with carriage initially at full aft position, then at increments along its range of motion - and repeated with blocking.

COMMENT: A difference with USAF procedures in that the carriage is adjusted to positions not chosen (or appropriate) for the subject. Data, therefore are gathered at carriage adjust positions inappropriate for the subjects body size, real or obtained through blocking. Buttock-Knee Length is not acknowledged as important in leg clearance. Again, "appropriate" seat positions are proposed without further discussion of "why."

THIGH GAP

TEXT: Thigh Gap measurements are made for comparison with injury records "to determine if thigh gap may be excessive." Also considered a measure of general sitting comfort.

Dimension is measured from hard seat pan edge to underside of the thigh "perpendicular to the femur." Seat and pedals are adjusted "to provide comfortable access to full pedal actuation." Measurements are taken "throughout full pedal motion," i.e., neutral, full forward, and full brake rotation at full forward pedal. The "fleshiness" of the thighs before bone contact apparently is somehow considered. Uncertainties "are partially countered by using same set of subjects on all aircraft to be compared." This [of course] "minimizes anomalies between subjects." Thigh gap is measured for informational and comparison purposes only.

QUICK REF: Important body dimensions include "functional leg length, buttock-knee length, sitting knee height, thigh circumference, and lower thigh circumference."

COMMENT: None.

EJECTION CLEARANCES

TEXT: Recommends seat pulls.

QUICK REF: Proposes seat pulls from more than one "predefined seat position" and with blocking.

COMMENT: Does not discuss the uncertain and loose relationships between these static measurements and the dynamics of an actual ejection. I cannot perceive the advantage of taking measurements while pulling the seat up the rails versus USAF procedures. I question the value of using blocks,* presumably behind the lower back, to simulate the effect of increased Buttock-Knee Length. No discussion of shoulder and elbow clearances.

* NOTE: On all occasions in which blocking is proposed to simulate larger body dimensions, and there are many, there is no discussion of observing the ranges of values for Buttock-Knee Length or Sitting Knee Height.

TASK 8 ...shall perform statistical analyses and comparison of a sample of 500 USAF fliers, 500 Navy fliers, and 9,000 Army soldiers...to determine if the three services can share large anthropometric data pools...

This task was inactive during this reporting period.

TASK 9 ...shall develop statistical techniques for the summarization of three-dimensional shape data which is being gathered on the human body...The eventual goal of this research is to be able to describe and summarize the variability in the shape of the human body, and create summarized (or composite) body forms.

This task was inactive during this reporting period.

TASK 10 ...shall develop a graphical design package to facilitate the use of 3-D data collected during the survey...including an "anthropometric clothing pattern production" tool...a "fit checking" tool:..and a "customized fit" tool...

This task was inactive during this reporting period.

TASK 11 ...shall investigate methods for determining the relationship between dexterity performance and hand and wrist size, shape, and kinematics...

Work under this task was not initiated.

TASK 12 ...shall use existing software, the on-line CARD Database, and AAMRL human mass distribution and volume data...in the solution of specific applied design problems as required by the Air Force...

Evaluations of Commercial Hardware and Software

CARD Laboratory Hardware

During this last reporting period the CARD laboratory relocated. Prior to the move, data on the Silicon Graphics workstations were backed up. Transceivers were obtained which allowed for the connection of the Silicon Graphics computers to the ethernet network. Personal computers were also connected to allow for access to the network by laboratory personnel.

A problem with the ethernet dropping out was identified and called into Silicon Graphics. Support of this call within the laboratory has been turned over to Lou Storey, LTSI.

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APPENDIX A

FUNCTION/GOALS MATRIX

The purpose of the attached **Function/Goals Matrix** is to cross reference the goals of the Lab with the functions that support the accomplishment of those goals. Goals are documented in the **CARD Lab Mission and Goals Hierarchy,** while functions are documented in the **CARD Lab Enterprise Model.**

The following points are important for understanding the Matrix.

- When looking at the Matrix, goals are listed along the left side of the page while functions are listed along the top.

- The matrix represents support for goal/sub-goal accomplishment by the lowest functional level from which that support comes. Although not shown on the Matrix, goal support "bubbles up" through the hierarchy of goals and functions.

- The evaluation behind the check marks is admittedly subjective. This set of check marks is our assessment of functions which have historically supported or currently do support the accomplishment of the goals.

- A check mark in a given Matrix cell does not imply any level of **strength** of support. It only indicates that the function does, to some degree, support goal accomplishment. For many goals, significantly increased support is required to accomplish the goal and thereby improve Lab performance. It is very difficult for us to assess the strength of support for goal accomplishment, given that time horizons were not attached to the goals and that measures have not been developed to monitor progress toward goal accomplishment.

The following steps can be followed to improve the overall operation of the Lab by accomplishing the goals:

- Prioritize the goals and identify those most vital to the success of the Lab.

- Establish a time horizon for the accomplishment of each goal. For example:
  short term -- under 1 year
  medium term -- 1 to 3 years
  long term -- over 3 years.

- Assign responsibility for each Lab functional area and set of goals.

- The individual(s) responsible for each Lab functional area should assume ownership for the accomplishment of the goals supported by the functions in that area.

- The goal owner(s) should develop a plan to accomplish the goal over the established time horizon.

- Develop a mechanism to measure and monitor goal accomplishment. Such a mechanism provides the goal owner, and other interested parties, with the capability to determine what progress has been made toward the accomplishment of a given goal. The mechanism, typically one or more measurable items for each sub-goal, is designed to answer the question: "How can we tell when this goal is achieved?"

- Publish periodic memoranda reporting progress toward goal accomplishment.

We will document our observations concerning the Lab goals and the current support provided for goal accomplishment in the Project Final Report.

	1.1.1.1 Formulate Question	1.1.1.2 Hypothesize Approach	1.1.1.3 Prototype Approach	1.1.1.4 Test Method	1.1.2 Acquire Data	1.1.3 Analyze Data	1.1.4 Publish/Present Results	1.1.5 Establish Standards	1.1.6 Serve on Working Groups	1.2.1.1 Assist With Req. Docs.	1.2.1.2 Participate in Briefings	1.2.1.3 Evaluate Proposals	1.2.2 Serve As Expert Witness	2.1 Identify Opportunities	2.2 Educate Users and Designers	2.3 Advertise Lab
1.1 Expand Depth of Data Pool	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓			
1.2 Expand Breadth of Data Pool	✓	✓	✓	✓	✓	✓	✓	✓	✓				✓			
1.3 Maintain Data Currency					✓	✓	✓									
2.1.1 Improve Fit Quantification	✓	✓	✓	✓		✓			✓						✓	
2.1.2 Develop New Fit Methods	✓	✓	✓	✓		✓									✓	
2.1.3 Define Fit Procedures							✓	✓	✓	✓					✓	
2.2.1 Improve Data Accuracy	✓	✓	✓	✓	✓				✓							
2.2.2 Increase Acquistion Speed	✓	✓	✓	✓	✓				✓							
2.3.1 Improve Shape Methods	✓	✓	✓	✓					✓							
2.3.2 Develop Auto Landmarking	✓	✓	✓	✓												
2.3.3 Compare Surface of Objects	✓	✓														
2.3.4 Develop Data Use Methods	✓	✓	✓	✓					✓							
2.4 Develop Finite Element Tools	✓	✓														
2.5 Develop Bio-Mech. Modeling									✓							
2.6 Move Towards Virtual Reality																
3.1 Evaluate/Select Methodology																
3.2 Develop Integrated Toolset																
3.3.1 Provide Data Accessibility					✓											
3.3.2 Provide Tool Accessibility																
3.3.3 Provide On-Line Help																
3.3.4 Provide Mobile Data Entry																
3.3.5 Develop GUI																
3.3.6 Provide Graphical Displays																
3.4 Enhance Information Network																
3.5.1 Develop Data Standards								✓	✓							
3.5.2 Design Data Representation																
3.5.3 Develop Data Reduction																
3.6 Keep Current with Technology									✓							
4.1 Develop Service Strategy									✓					✓		
4.2.1 Influence Procurement								✓	✓	✓	✓	✓	✓		✓	✓
4.2.2 Educate/Train Designers									✓	✓	✓	✓		✓	✓	
4.2.3 Educate Lab Personnel									✓		✓					
4.2.4 Expand Role in Design									✓	✓	✓	✓		✓	✓	✓
4.2.5 Promote Advances							✓	✓	✓		✓		✓			✓
4.3 Raise Awareness of Lab							✓		✓	✓	✓	✓	✓	✓	✓	✓
4.4 Enhance Service Offerings	✓	✓	✓	✓	✓				✓	✓	✓	✓		✓	✓	
4.5 Enhance User Support									✓	✓	✓	✓			✓	
4.6 Maintain Global Awareness									✓							
5.1 Enhance Staff Skills									✓							
5.2 Prioritize Lab Activities																
5.3 Improve Communications																
5.4 Improve Workload Management																

	3.1 Monitor Technological Trends	3.2.1 Maintain User Base	3.2.2 Monitor Usage/Performance	3.2.3 Back up System Drives	3.3.1 Determine Requirements	3.3.2 Evaluate & Select SW/HW	3.3.3 Install New SW/HW	3.4 Develop I.S. Methods	3.5.1 Develop Routines	3.5.2 Develop Data Systems	3.6 Train in System Use	4.1 Manage Lab Budgets	4.2.1 Sponsor Training	4.2.2 Manage Workloads	4.3 Manage Facilities/Equipment
1.1 Expand Depth of Data Pool												✓		✓	✓
1.2 Expand Breadth of Data Pool												✓		✓	✓
1.3 Maintain Data Currency												✓		✓	✓
2.1.1 Improve Fit Quantification								✓	✓			✓		✓	
2.1.2 Develop New Fit Methods												✓		✓	
2.1.3 Define Fit Procedures												✓		✓	
2.2.1 Improve Data Accuracy					✓	✓	✓	✓	✓	✓		✓		✓	✓
2.2.2 Increase Acquistion Speed					✓	✓	✓	✓	✓	✓		✓		✓	✓
2.3.1 Improve Shape Methods								✓	✓	✓		✓		✓	
2.3.2 Develop Auto Landmarking								✓	✓	✓	✓	✓		✓	
2.3.3 Compare Surface of Objects								✓	✓		✓	✓		✓	
2.3.4 Develop Data Use Methods	✓							✓	✓	✓		✓		✓	
2.4 Develop Finite Element Tools								✓	✓			✓		✓	
2.5 Develop Bio-Mech. Modeling												✓			
2.6 Move Towards Virtual Reality	✓											✓			
3.1 Evaluate/Select Methodology	✓				✓	✓		✓				✓	✓		
3.2 Develop Integrated Toolset	✓				✓	✓				✓		✓			
3.3.1 Provide Data Accessibility	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓		✓	
3.3.2 Provide Tool Accessibility	✓	✓	✓	✓	✓	✓	✓		✓	✓		✓		✓	
3.3.3 Provide On-Line Help									✓	✓					
3.3.4 Provide Mobile Data Entry	✓								✓		✓	✓			
3.3.5 Develop GUI	✓				✓	✓		✓	✓	✓		✓		✓	
3.3.6 Provide Graphical Displays	✓								✓	✓					
3.4 Enhance Information Network	✓				✓	✓	✓		✓	✓		✓		✓	
3.5.1 Develop Data Standards	✓				✓										
3.5.2 Design Data Representation	✓							✓	✓	✓		✓		✓	
3.5.3 Develop Data Reduction								✓	✓	✓		✓			
3.6 Keep Current with Technology	✓				✓	✓						✓	✓		
4.1 Develop Service Strategy					✓							✓			
4.2.1 Influence Procurement												✓		✓	
4.2.2 Educate/Train Designers											✓	✓			
4.2.3 Educate Lab Personnel												✓			
4.2.4 Expand Role in Design												✓			
4.2.5 Promote Advances									✓			✓		✓	
4.3 Raise Awareness of Lab												✓			
4.4 Enhance Service Offerings								✓	✓	✓		✓		✓	
4.5 Enhance User Support			✓		✓	✓	✓	✓	✓	✓	✓	✓		✓	
4.6 Maintain Global Awareness												✓			
5.1 Enhance Staff Skills											✓	✓	✓		
5.2 Prioritize Lab Activities												✓		✓	✓
5.3 Improve Communications												✓		✓	
5.4 Improve Workload Management												✓		✓	

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APPENDIX B

SURVEY RESULTS

This document presents our analysis of the responses to the Questionnaire For Potential Users of the CARD Lab Data and Services. We received thirteen (13) completed survey responses from external organizations, and one from inside the Lab. This level of response was much less than we expected. A more extensive distribution of this Questionnaire would have provided more responses, and correspondingly, a better basis for understanding the requirements of current and prospective Lab customers.

The following external organizations provided responses:

- AL/CFBV (2)
- Sytronics, Inc.
- Bose Corp.
- Systems Research Lab
- Rose Imaging
- ILC Dover, Inc.
- Lockheed - Fort Worth Division
- U. S. Army Natick RD&E Center
- Naval Air Warfare Center - Warminster (2)
- GEC Marconi Avionics, Ltd.
- ITT

We have attached a copy of the Questionnaire, with the responses tallied and all relevant comments listed. These summarized responses provide insight into respondents' requirements for:

- import and export data formats
- network access
- categories of anthropometric data
- analytic capabilities, and
- other assistance and support.

These responses will prove useful as input to subsequent analysis and design steps for the integrated CARD Lab Data System. For example, the Lab should determine which of the import and export data formats are to be included in the scope of the Data System, thoroughly analyze those formats, and design the Data System to accommodate the formats. Likewise, the responses on the categories of data will be useful in designing data access paths.

Based on our analysis of the summarized responses we have concluded that there is **no impact** on the "First Cut" Enterprise and Conceptual Data Models.

Under separate cover, we have enclosed the original completed survey responses.

Note: Due to overlapping answers, survey responses for a given question can not be accumulated to arrive at the total number of surveys returned. For example, there are more responses for "Principal Occupation" than the number of surveys returned due to one or more respondents categorizing themselves under multiple occupational categories.

— Summarized Responses —

QUESTIONNAIRE FOR POTENTIAL USERS OF THE CARD LAB DATA AND SERVICES

Date: [ ] [ ] [ ]
M D Y

Background

Name ______________________________

Organization ______________________________

Organization Address ______________________________

____

Country ______________________________

Phone ( ) ______________________________

Principal Occupation (*Check appropriate box*)

Engineering	7
Engineering Research	5
Modeling/Simulation	2
Medical Practice	
Medical Research	1
Other (*list*) Research Anthropologist	1
Anthropometrics	1

Applications

What projects are you currently engaged in or have planned that could benefit from traditional anthropometric and/or 3D surface or subsurface data on the human body? (*Check all that apply*)

Design of protective equipment/clothing	8
Design of prosthetic devices	3
Evaluation of protective equipment/clothing	7
Evaluation of prosthetic devices	1
Reconstructive surgery	1
Other medical applications (*list*)	
Aids for physically challenged	1
Cranial/facial surgery	1

Design of cockpits	8
Design of workstations	5
Computerized human modeling	7
Physical human modeling	7
Automated manufacturing	2
Custom manufacturing	4
Other (*List*)	
3D data applications research	1
Head/helmet mounted display	1
Head/helmet mounted night vision goggles	1

CARD LAB QUESTIONNAIRE
Page 2

Computer and Communications Capabilities

1. What types of computers will you have available to you at your facility? *(Check all that apply)*

386/486 personal computers	14	VAX mainframe	7
Macintosh personal computers	7	IBM mainframe	2
Other personal computers (*list*)		Cray mainframe	2
286 personal computers	2	Other mainframes (*list*)	
		Convex	1
Silicon Graphics workstation	10		
Other graphics workstations (*list*)		Other (list)	
DEC workstation	5	HP 9000 Server	1
Sun Sparc	8		
Apollo	1		
Prime	1		

2. Do you generally have access to the following? (*Check all that apply, and list the hardware or package(s) used.*)

Electronic mail network daily?	12	
Graphics workstation(s)?	14	
Mainframe computers as needed?	8	
Personal computer(s) as needed?	14	
Statistical analysis software?	10	
Word processing software?	14	
Windowing software?	13	
Spreadsheet software?	14	
Drawing software?	14	
CAD software?	13	
Visualization software?	6	
CASE tool software?	4	

3. What database management technology is available for your use? (*Check all that apply and list the package(s) used.*)

Relational	13	
Object oriented	4	
Other		

What software languages are available for use at your facility? (*Check all that apply*)

Fortran	14
C	14
C++	11
Ada	6

Other language(s) (*List*)

Pascal	5	PV-Wave	1
Assembler	3	Basic	3
Lisp	3	Turbo Basic	1
PLI	1		

4. What import or export 3D data formats are available to your facility? (*Check all that apply*)

	Import	Export
IGES	9	8
Cyberware	3	2
PATRAN		
.DXF	8	7
ASCII Point List	6	6
STL (Stereolithography formatting)	5	6
ACR-NEMA DICOM	1	1

	Import	Export
QUICKMODEL	1	1
POSTSCRIPT	6	6
QUADRAX		
AUTOCAD	11	11
Color Postscript	3	3
CADKEY	1	1
Voxel View	1	1
Unigraphics	2	2

	Import	Export
IDEAS	3	3
PROENGINEER	3	3
Other (*List*)		
ADRA	1	1

5. Do you have access to Internet? **10-Y** **N-3** (**1** In Progress)

6. Do you have access to Bitnet? **1-Y** **N-11**

7. List other networks to which you have access.

DDN	1	Local Ethernet	1
Bulletin Boards	1	MILNET	1

8. Do you have access to a modem? **12-Y** **N-1** (Classified)

Anthropometric Data and Analytics

9. Do you have access to any of the following types of anthropometric data? (*Check applicable boxes and list outside sources if any*)

	Published Tabulated Statistical Tables	Raw Electronic Data: In-house Collected	Raw Electronic Data: Outside Source	
Traditional anthropometric measurements	14	9	7	______
Human-system interface data (e.g., Clothing or helmet fit, cockpit accommodation)	9	4	4	______
3-dimensional human body surface data	7	4	5	______
3-dimensional human body subsurface data (MRI, CT)	3	2	2	______

10. If you have access to equipment for collecting high resolution 3-dimensional surface or subsurface data on the human body, to what type(s) of systems do you have access? (*Check all that apply*)

Cyberware Echo digitizer	3
Linney laser system	
Laser range finder system	
Cencit scanner	1
Stereophotometric system	
with automated system	1
-or-	
with manual processing	1
LASS	

Other surface system (*List*)	
Laser design	1
3-D sonic digitizer	1
MRI	2
CT scanner	2
Other subsurface system (*List*)	
______	
______	

11. Which of the following types of data would be useful to you? (*Check all that apply.*)

Traditional anthropometric measurements

Categorized by Population	14
Categorized by Body Region	12
Categorized by Measurement Type	12

11. Which of the following types of data would be useful to you? (Cont'd.) (*Check all that apply.*)

3-dimensional human body surface data

Categorized by Population	13
Categorized by Body Region	14
Categorized by Measurement Type	14

3-dimensional human body subsurface data (MRI, CT)

Categorized by Population	5
Categorized by Body Region	5

Human-system interface data

Prosthetic devices	3
Other medical devices	3
Clothing	6
Protective equipment	11
Cockpit	9
Other workstations	6

Other (*Please describe*)

Aids for physically challenged	1	Wheelchairs	1
Head to helmet fit	1	Beds	1
Fit to vision (LOS & facial)	1	Lavatory	1

12. Please check the sections or aspects of human body data that are of most interest to you.

Head	11
Hands	6
Upper body	9
Lower body	5
Whole body	9
Bio-mechanical/movement	8

Other (*Please discuss*)

Ears and contours of head behind ears 1

13. What analytic capabilities would you want to apply against the 2- and 3-dimensional anthropometric data covered in previous questions? (*Check all that apply.*)

Linear statistics	10
Multivariate statistics	9
Surface descriptor or algorithms	7
Shape quantification	9
Shape summarization	7
Distance calculations (Curvature, point-to-point, volumes, areas, mass properties)	14
Non-linear calculations	5
3-dimensional data editing	7
Data segmentation	8
Other (*Please describe*)	
Automated isolation and presentation	1
Surface area	1
Volume and center of volume	1
Center of mass and inertial properties	1

14. Would you prefer to store, access, and process 2- and 3-dimensional anthropometric data at your site on your computers, or have remote access (through a network or a modem) to such data and processing capabilities?

Local storage, access, processing	10
Remote access	8

Comments

Would like access to raw data	1
Download and store locally with quarterly updates	2
Depending on funding and access requirements	1
Remote access eliminates maintenance and update of on-site data base	1
A convenient system of remote access would allow us to download data when necessary	1
It would be useful to hold the analytical 'tools' on site and be able to access various data packages as required (remote access)	1

15. Please describe the type(s) of help you would need to take greatest advantage of the data and analytic resources available through the Computerized Anthropometric Research and Design (CARD) Lab. Consider both on-line help as well as expertise and advice provided by Lab personnel.

Cross-referenced data	1
Edited data	2
Locating extremes (outliers)	1
On-line help	2
Groupware for research	1
Obtaining data	1
Understand format	2
Database manipulation	2
Validation/verification of data	1
System fit analysis with CARD data	1
Access to fit performance	1
Access to anthro data	1
Cockpit accommodation queries	1
Helmets	1
Caution about use/misuse of data	1
Raw data access	2
Statistical support	1
Tutorial/primer on how to use and the capabilities	3

15. Please describe the type(s) of help you would need to take greatest advantage of the data and analytic resources available through the Computerized Anthropometric Research and Design (CARD) Lab. Consider both on-line help as well as expertise and advice provided by Lab personnel. (Continued)

A summary manual describing the database setup and its operation	1
Points of contact to answer questions regarding operation and data	1
It is likely that we will need both 'systems' and 'application' advice since the amount of computerized anthropometric analysis knowledge we have is very limited	1

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APPENDIX C

CARD LAB CONCEPTUAL DATA MODEL - "FINAL"

This deliverable includes the three documents that make up the Conceptual Data Model:

- Entity Relationship Diagram
- Entity Report
- Relationship Report.

The following points are important for understanding the Lab's Conceptual Data Model:

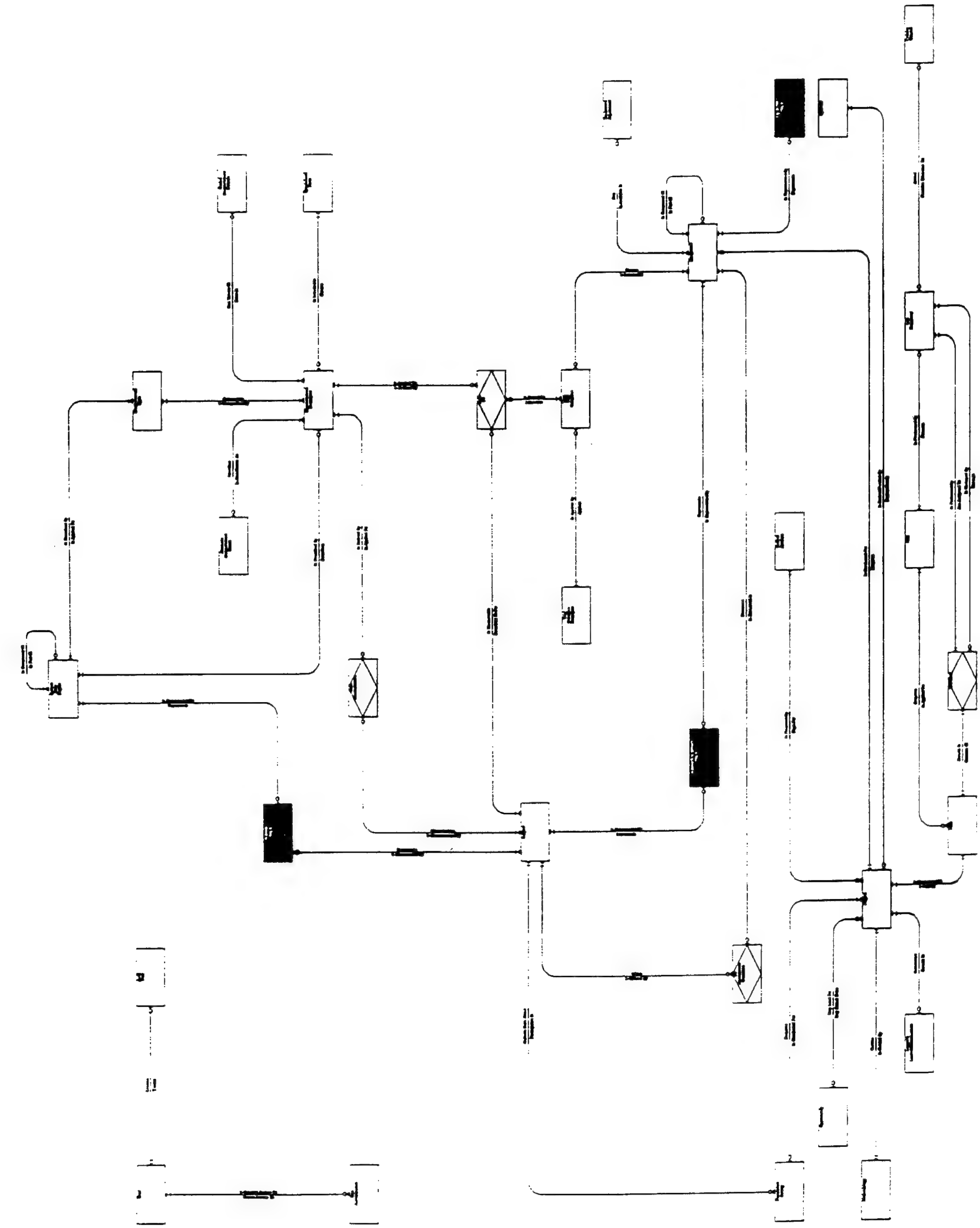
- We do not show summarized data in the Model. Instead we show the raw data collected during a study/survey as entities in the Model. Determination of what to do with summarized data is best dealt with as a design decision, with the two major alternatives being to store the statistically summarized data as a table or to recalculate the statistical summaries when needed.

- Three dimensional scan images are shown on the Entity Relationship Diagram as black boxes with white text to distinguish them from the tabular collections of data.

- The entities shown on the Entity Relationship Diagram as rectangles with diamonds inside are a special type of entity known as an associative entity. These entities contain data that result from a relationship between two or more other entities. For example, the entity "Raw Measurement" will contain the raw data resulting from taking specific measurements of a specific subject. "Raw Measurement" cannot exist without a "Subject" entity and a "Measurement Descriptor" entity.

- The user-related entities (User, User Authorization, Audit Trail) and corresponding relationships form the conceptual design for a User Database. While these entities provide control over, and tracking of, access and use of the remainder of the integrated CARD Lab data resource, there is no natural relationship between any of these entities and any of the remaining entities. Therefore, these entities are depicted in a "stand-alone" fashion.

ENTITY RELATIONSHIP DIAGRAM



ENTITY REPORT

Entity Type: Alternate Measurement Name

Definition
An alternate name by which a measurement is known and may be accessed.

Comments
Identifier: Alternate Measurement Name

Other Attributes: Measurement Title

Entity Type: Audit Trail

Definition
Tracks the usage and navigational paths followed by the user during a specific session. In essence, this serves as a "script" of everything the user did during the session.

Comments
The user will be given the option of saving a maximum number of audit trail "files" for future use and reference. This number has not yet been determined.

Identifier: Session Date + Session Name

(Note: The user can be prompted for a session name for those sessions he/she wishes to save.)

Entity Type: Budget Account

Definition
A specified amount of budgeted funds, allocated for a specific purpose or against an approved project.

Comments
Identifier: Account Number

Other Attributes: Amount Budgeted, To Date Amount Spent

Entity Type: Coded Measurement Domain

Definition
The domain of valid values for measurements which are coded.

Comments
Identifier: Measurement Title + Measurement Code

Other Attributes: Measurement Code Value

Entity Type: Equipment

Definition
An item of clothing, personal protective equipment, aircraft, or other equipment of interest in an anthropological study.

Comments
Due to the recursive relationship, this entity encompasses the hierarchy of an equipment family. For example, for an aircraft this entity will capture the following:

Category
|
Aircraft
|
Crewstation
|
Control Region
|
Control

Identifier: Equipment Type + Equipment Identifier

Other Attributes: Serial Number, Equipment Description

Entity Type: Equipment Adjustment

Definition
The adjustments available for a given item of equipment. This includes the range of sizes for clothing and personal protective equipment, adjustments available for aircraft seat position, adjustments available for vision systems within a helmet, etc.

Comments
Identifier: Equipment Type + Equipment Identifier + Adjustment Identifier

Other Attributes: Adjustment Increment, Maximum Adjustment, Range of Adjustment

Entity Type: Equipment Image

Definition
A three dimensional image, either surface or subsurface, of a specific item of equipment.

Comments
Identifier: Equipment Type + Equipment Identifier

Other Attributes: Scan Date

Entity Type: Fit Assessment Comment

Definition
A comment made by the subject or the investigator about some aspect of the comfort or fit of a specific item of clothing or personal protective equipment.

Comments
Identifier: Subject Number + Subject Name + Equipment Type + Equipment Identifier

Other Attributes: Subject Comments, Investigator Comments

Entity Type: Human Body Region

Definition
A region of the human body, ranging from the whole body to a more minute section, such as a hand.

Comments
Identifier: Body Region Name

Entity Type: Lab Personnel

Definition
A human resource available to the Lab. May be a Government or a contractor employee.

Comments
Identifier: Personnel Name

Other Attributes: Employer

Entity Type: Lessons Learned/Conclusions

Definition
Text discussion of the lessons learned and conclusions for a specific project.

Comments
Identifier: Conclusion Identifier

Other Attributes: Lessons Learned/Conclusion Text

Entity Type: Measurement Descriptor

Definition
A specific anthropometric measurement to be applied in a study or survey.

Comments
Identifier: Measurement Title

Other Attributes: Measurement Description

Entity Type: Measurement Type

Definition
A means to classify and group anthropometric measurements.

Comments
Identifier: Measurement Type

Other Attributes: Measurement Type Description

Entity Type: Methodology

Definition
The approach and guidelines used to conduct a specific Lab project.

Comments
Identifier: Methodology Name

Entity Type: Opportunity

Definition
A possible new project (study, survey, fit assessment, etc.) which the Lab could undertake for a sponsor.

Comments
Identifier: Opportunity Identifier

Other Attributes: Potential Sponsor, Opportunity Description

Entity Type: Population Survey

Definition
A survey of a specific population group, such as "USAF Flying Personnel 1967".

Comments
Identifier: Population Survey Identifier

Other Attributes: Survey Description, Survey Date

Entity Type: Project

Definition
A fit assessment, population survey, cockpit or crewstation accommodation study, or some other work undertaken for, or on behalf of, a sponsoring organization.

Comments
Identifier: Project Identifier

Other Attributes: Project Description, Start Date, End Date

Entity Type: Raw Fit

Definition
A raw data value for a specific anthropometric measurement taken at a specific point in time for a specific subject to assess the fit or accommodation of a specific item of equipment, given specific trial conditions.

Comments
Identifier: Subject Number + Subject Name + Measurement Title + Equipment Type + Equipment Identifier + Test Trial Number

Other Attributes: Fit Measurement Value

Entity Type: Raw Measurement

Definition
A raw data value for a specific anthropometric measurement taken at a specific point in time for a specific subject.

Comments

Identifier: Subject Number + Subject Name + Measurement Title

Other Identifier: Measurement Value

Entity Type: Skill

Definition
The knowledge, proficiency, or ability required to accomplish a specific task.

Comments
Identifier: Skill Name

Other Attributes: Skill Description

Entity Type: Specialized Term

Definition
A term used in any aspect of engineering anthropometry for which a system user may require a definition.

Comments
Identifier: Specialized Term

Other Attributes: Term Description

Entity Type: Sponsor

Definition
The organization for which a Lab project is undertaken. This may be an organization external to the Lab, or it may be the Lab itself.

Comments
Identifier: Organization

Other: Sponsor Key Contact Name, Address, Phone Number

Entity Type: Subject

Definition
A subject participant in a population survey, fit assessment, cockpit accommodation study, or other type of study.

Comments
Identifier: Subject Number + Subject Name

Other Attributes: Date of Birth, Age at Last Birthday, Place of Birth, Race, Rank, Gender, Branch of Service

Entity Type: Subject Image

Definition
A three dimensional image, either surface or subsurface, of a specific human subject or some body region of a human subject.

Comments
Identifier: Subject Number + Subject Name + Body Region Name

Other Attributes: Scan Date

Entity Type: Subject/Equipment Image

Definition
A three dimensional image, either surface or subsurface, involving a specific human subject and a specific item of equipment. This provides a "picture" of the human-equipment interface.

Comments
Identifier: Subject Number + Subject Name + Equipment Type + Equipment Identifier

Other Attributes: Scan Date

Entity Type: Task

Definition

A discrete unit of work activity. Includes a description of the work to be accomplished and an estimate of the time required to complete the work.

Comments
Identifier: Task Name

Other Attributes: Task Description, Time Required To Perform

Entity Type: Test Trial Condition

Definition
The specific conditions under which a specific measurement is taken. This could include: configuration, temperature, lighting, aircraft seat position, angle of orientation, etc.

Comments
Identifier: Equipment Type + Equipment Identifier + Trial Condition Name

Other Attributes: Condition Value

Entity Type: Training Course

Definition
Formal training or continuing education intended to impart required knowledge, ability, or skill.

Comments
Identifier: Training Course Name

Entity Type: Trial Condition Descriptor

Definition
Description of a specific condition under which a measurement might be taken in a trial of a study test.

Comments

Identifier: Trial Condition Name

Other Attributes: Trial Condition Description

Entity Type: User

Definition
An individual or organization authorized to access and use CARD Lab data, hardware, and/or software tools.

Comments
Identifier: User Name

Other Attributes: Organization, Phone Number, Address

Entity Type: User Authorization

Definition
The specific access and use capabilities granted to an individual user or organization.

Comments
Identifier: Authorization Level

Other Attributes: Privilege Granted

Entity Type: Workload

Definition
The amount of work, in the form of specific tasks, assigned to a specific Lab "employee" during a given period of time.

Comments
Identifier: Personnel Name + Task Name

Other Attributes: Estimated Time Required, Start Date, End Date

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RELATIONSHIP REPORT

Relationship Type: Test Trial Condition.Applies.Trial Condition Descriptor

PROPERTY	VALUE
To From Name	Is Applied By
From To Minimum	1
From To Maximum	1
To From Minimum	0
To From Maximum	M
Last Update	1993/07/28 13:00:55 CHUCKS
Created	1993/07/28 13:00:55 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Lab Personnel.Are Assigned To.Workload

PROPERTY	VALUE
To From Name	Is Performed By
From To Minimum	1
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/05/11 07:29:28 MARKW
Created	1993/05/10 12:34:37 MARKW

ASSOCIATION	TYPE	NAME

Relationship Type: Lab Personnel.Attend.Training Course

PROPERTY	VALUE
To From Name	Provides Education To
From To Minimum	0
From To Maximum	M

To From Minimum	0
To From Maximum	M
Last Update	1993/05/11 07:50:40 MARKW
Created	1993/05/10 12:10:47 MARKW

ASSOCIATION	TYPE	NAME

Relationship Type: Population Survey.Collects Data About.Subject

PROPERTY	VALUE
To From Name	Participates In
From To Minimum	1
From To Maximum	M
To From Minimum	0
To From Maximum	M
Last Update	1993/07/14 09:42:49 CHUCKS
Created	1993/07/12 08:27:16 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: User.Creates.Audit Trail

PROPERTY	VALUE
To From Name	Tracks
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/07/28 10:32:42 CHUCKS
Created	1993/07/28 10:32:42 CHUCKS

ASSOCIATION	TYPE	NAME

CARD Lab Relationship Report
Object Summary Report

Relationship Type: Sponsor.Desires/Funds.Project

PROPERTY	VALUE	
To From Name	Is Desired/Funded By	
From To Minimum	0	
From To Maximum	M	
To From Minimum	1	
To From Maximum	M	
Last Update	1993/07/28 13:38:07 CHUCKS	
Created	1993/05/10 12:03:24 MARKW	
ASSOCIATION	TYPE	NAME

Relationship Type: Equipment.Has.Equipment Adjustment

PROPERTY	VALUE	
To From Name	Is Available In	
From To Minimum	0	
From To Maximum	M	
To From Minimum	1	
To From Maximum	1	
Last Update	1993/07/15 14:34:46 CHUCKS	
Created	1993/07/14 08:44:40 CHUCKS	
ASSOCIATION	TYPE	NAME

Relationship Type: Measurement Descriptor.Has Values Of.Coded Measurement Domai

PROPERTY	VALUE
To From Name	Bounds
From To Minimum	0
From To Maximum	M
To From Minimum	1

To From Maximum	1
Last Update	1993/07/14 10:02:56 CHUCKS
Created	1993/07/12 08:42:18 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Test Trial Condition.Influences.Raw Fit

PROPERTY	VALUE
To From Name	Is Based On
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/07/28 13:35:21 CHUCKS
Created	1993/07/12 09:39:43 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Measurement Descriptor.Is Also Known As.Alternate Measurement Name

PROPERTY	VALUE
To From Name	Identifies
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	M
Last Update	1993/07/14 10:01:17 CHUCKS
Created	1993/07/12 08:38:31 CHUCKS

ASSOCIATION	TYPE	NAME

CARD Lab Relationship Report
Object Summary Report

Relationship Type: Measurement Descriptor.Is Applied To.Raw Measurement

PROPERTY	VALUE
To From Name	Is Defined By
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/07/28 13:32:29 CHUCKS
Created	1993/07/08 15:53:36 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Measurement Descriptor.Is Applied To.Raw Fit

PROPERTY	VALUE
To From Name	Is Defined By
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/07/28 13:33:10 CHUCKS
Created	1993/07/12 09:02:10 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Measurement Type.Is Applied To.Human Body Region

PROPERTY	VALUE
To From Name	Is Described By
From To Minimum	1
From To Maximum	M
To From Minimum	1

To From Maximum	M
Last Update	1993/07/28 13:09:40 CHUCKS
Created	1993/07/28 13:09:40 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Measurement Descriptor.Is Categorized By.Measurement Type

PROPERTY	VALUE
To From Name	Categorizes
From To Minimum	1
From To Maximum	1
To From Minimum	1
To From Maximum	M
Last Update	1993/07/14 10:02:04 CHUCKS
Created	1993/07/12 08:40:19 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Subject.Is Characterized By.Raw Measurement

PROPERTY	VALUE
To From Name	Characterizes
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/07/14 09:48:34 CHUCKS
Created	1993/07/12 08:21:23 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Project.Is Composed Of.Task

CARD Lab Relationship Report
Object Summary Report

PROPERTY	VALUE	
To From Name	Is Part Of	
From To Minimum	1	
From To Maximum	M	
To From Minimum	1	
To From Maximum	1	
Last Update	1993/05/11 07:55:07 MARKW	
Created	1993/05/10 12:24:35 MARKW	
ASSOCIATION	TYPE	NAME

Relationship Type: Human Body Region.Is Composed Of.Human Body Region

PROPERTY	VALUE	
To From Name	Is Part Of	
From To Minimum	0	
From To Maximum	M	
To From Minimum	1	
To From Maximum	1	
Last Update	1993/07/15 14:39:59 CHUCKS	
Created	1993/05/18 09:16:36 CHUCKS	
ASSOCIATION	TYPE	NAME

Relationship Type: Equipment.Is Composed Of.Equipment

PROPERTY	VALUE
To From Name	Is Part Of
From To Minimum	0
From To Maximum	M
To From Minimum	1

To From Maximum	1
Last Update	1993/07/15 14:40:34 CHUCKS
Created	1993/07/12 09:26:11 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Project.Is Conducted For.Population Survey

PROPERTY	VALUE
To From Name	Requires
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/07/14 09:14:43 CHUCKS
Created	1993/07/14 08:52:58 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Project.Is Conducted For.Equipment

PROPERTY	VALUE
To From Name	Requires
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/07/14 09:10:33 CHUCKS
Created	1993/07/14 09:10:33 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Human Body Region.Is Described By.Measurement Descriptor

PROPERTY	VALUE
To From Name	Describes
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/07/14 09:56:47 CHUCKS
Created	1993/05/14 11:38:49 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Equipment.Is Discussed In.Fit Assessment Comment

PROPERTY	VALUE
To From Name	Discusses
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/07/14 09:18:19 CHUCKS
Created	1993/07/12 09:37:10 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Project.Is Financed By.Budget Account

PROPERTY	VALUE
To From Name	Pays For
From To Minimum	1
From To Maximum	M
To From Minimum	0

To From Maximum	M
Last Update	1993/07/14 09:16:32 CHUCKS
Created	1993/07/12 12:35:00 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: User.Is Granted Access By.User Authorization

PROPERTY	VALUE
To From Name	Grants Access To
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/07/14 09:58:10 CHUCKS
Created	1993/07/12 12:29:35 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Project.Is Guided By.Methodology

PROPERTY	VALUE
To From Name	Guides
From To Minimum	1
From To Maximum	M
To From Minimum	1
To From Maximum	M
Last Update	1993/07/14 09:13:54 CHUCKS
Created	1993/07/12 13:19:45 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Measurement Descriptor.Is Included In.Specialized Term

PROPERTY	VALUE
To From Name	Covers
From To Minimum	1
From To Maximum	1
To From Minimum	0
To From Maximum	1
Last Update	1993/07/14 09:55:24 CHUCKS
Created	1993/07/12 08:44:55 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Equipment.Is Included In.Test Trial Condition

PROPERTY	VALUE
To From Name	Covers
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/07/28 14:45:09 CHUCKS
Created	1993/07/14 08:41:27 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Subject.Is Measured In.Raw Fit

PROPERTY	VALUE
To From Name	Describes Fit For
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1

Last Update	1993/07/28 14:42:54 CHUCKS
Created	1993/07/12 09:07:43 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Fit Assessment Comment.Is Offered By.Subject

PROPERTY	VALUE
To From Name	Offers
From To Minimum	1
From To Maximum	1
To From Minimum	0
To From Maximum	M
Last Update	1993/07/15 14:33:38 CHUCKS
Created	1993/07/12 09:35:43 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Human Body Region.Is Represented By.Subject Image

PROPERTY	VALUE
To From Name	Represents
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/07/15 14:42:42 CHUCKS
Created	1993/05/14 11:38:15 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Subject.Is Represented By.Subject Image

PROPERTY	VALUE
To From Name	Represents
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/07/15 14:43:37 CHUCKS
Created	1993/07/08 15:47:44 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Subject.Is Represented By.Subject/Equipment Image

PROPERTY	VALUE
To From Name	Represents
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/07/14 09:17:42 CHUCKS
Created	1993/07/12 09:30:28 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Equipment.Is Represented By.Subject/Equipment Image

PROPERTY	VALUE
To From Name	Represents
From To Minimum	0
From To Maximum	M
To From Minimum	1

To From Maximum	1
Last Update	1993/07/14 09:18:50 CHUCKS
Created	1993/07/12 09:31:12 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Equipment.Is Represented By.Equipment Image

PROPERTY	VALUE
To From Name	Represents
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/07/14 09:19:29 CHUCKS
Created	1993/07/12 09:33:09 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Lab Personnel.Manage.Workload

PROPERTY	VALUE
To From Name	Is Managed By
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/05/11 07:30:12 MARKW
Created	1993/05/11 07:30:12 MARKW

ASSOCIATION	TYPE	NAME

Relationship Type: Project.May Result From.Opportunity

PROPERTY	VALUE	
To From Name	May Lead To	
From To Minimum	0	
From To Maximum	M	
To From Minimum	0	
To From Maximum	M	
Last Update	1993/07/14 09:15:27 CHUCKS	
Created	1993/07/12 12:40:06 CHUCKS	
ASSOCIATION	TYPE	NAME

Relationship Type: Lab Personnel.Possess.Skill

PROPERTY	VALUE	
To From Name	Is Possessed By	
From To Minimum	1	
From To Maximum	M	
To From Minimum	0	
To From Maximum	M	
Last Update	1993/07/15 14:44:36 CHUCKS	
Created	1993/05/10 12:15:53 MARKW	
ASSOCIATION	TYPE	NAME

Relationship Type: Task.Requires.Skill

PROPERTY	VALUE
To From Name	Is Applied To
From To Minimum	1
From To Maximum	M
To From Minimum	0
To From Maximum	M

Last Update	1993/07/28 12:26:02 CHUCKS
Created	1993/07/28 12:26:02 CHUCKS

ASSOCIATION	TYPE	NAME

Relationship Type: Task.Results In.Workload

PROPERTY	VALUE
To From Name	Consists Of
From To Minimum	1
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/07/15 14:46:49 CHUCKS
Created	1993/05/10 12:33:46 MARKW

ASSOCIATION	TYPE	NAME

Relationship Type: Project.Results In.Lessons Learned/Conclusions

PROPERTY	VALUE
To From Name	Summarize
From To Minimum	0
From To Maximum	M
To From Minimum	1
To From Maximum	1
Last Update	1993/07/28 12:31:25 CHUCKS
Created	1993/07/28 12:31:25 CHUCKS

ASSOCIATION	TYPE	NAME

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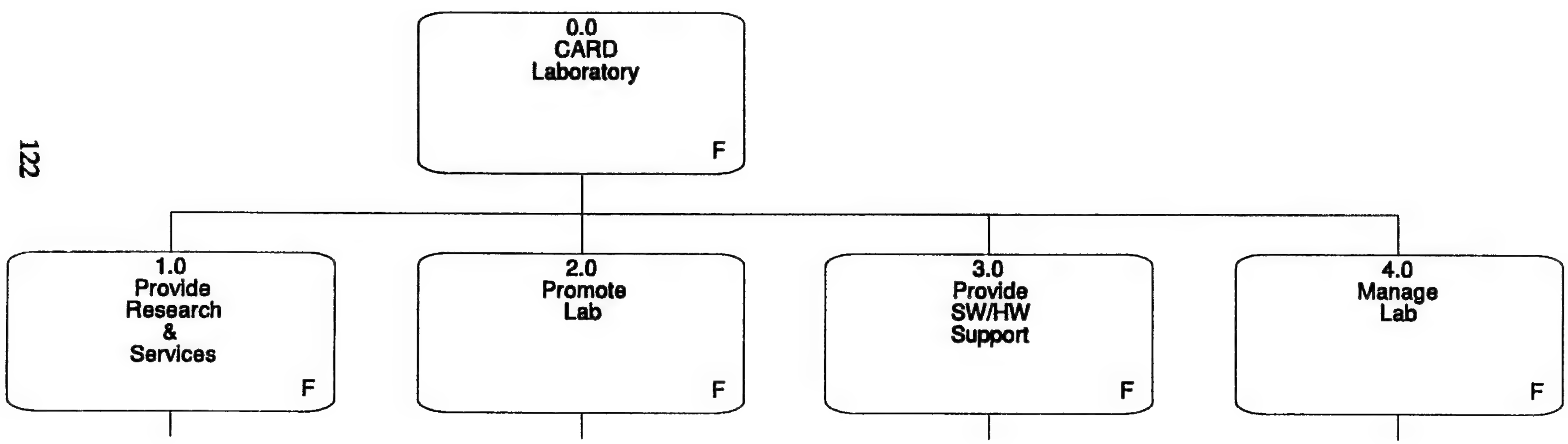
APPENDIX D

CARD LAB ENTERPRISE MODEL - "FINAL"



0.0
CARD
Laboratory
F
1.0
Provide
Research
&
Services
F
2.0
Promote
Lab
F
3.0
Provide
SW/HW
Support
F
4.0
Manage
Lab
F

Function: 0.0 CARD Laboratory

Definition
The Computerized Anthropometric Research and Design (CARD) Laboratory captures, analyzes, and provides information on human body size and shape, and the interface of the human body with equipment/systems, to evaluate and improve the design of clothing, personal protective equipment, and cockpits and other workstations.

Function: 1.0 Provide Research & Services

Definition
Conduct research to advance the state of the art of anthropometry and to answer specific questions posed by, or in support of, other organizations, and provide anthropometric consulting services to other organizations.

Comments
The CARD Lab conducts research to advance methods for defining and representing the size, shape (summarization and characterization), strength, dexterity, and functional characteristics of humans for use in the design of clothing, personal protective equipment, and workstations.

Research studies may be focused on different parts of the human body (for example, head, hands, total body, etc.) or on the human-system interface.

Research may be conducted for a specific sponsor or may be conducted as part of the research program of a member of the Lab staff.

Function: 2.0 Promote Lab

Definition
Promote the use of Lab research capabilities and data, as well as other anthropometric consulting services, and the benefits of using those services and data, by identifying opportunities for the application of

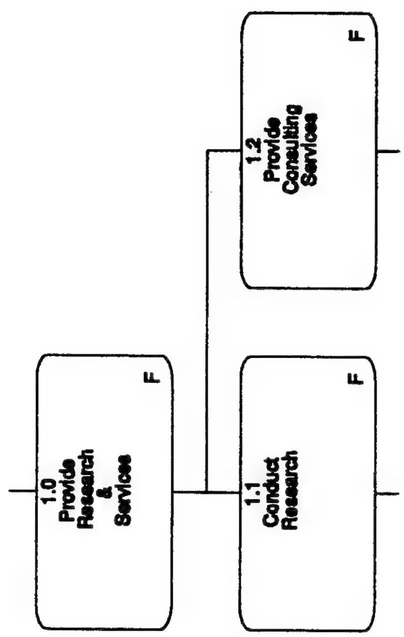
Lab capabilities, educating engineers and designers in the use of Lab data and services, participating on working groups, and advertising.

Function: 3.0 Provide SW/HW Support

Definition
Provide computer software and hardware support for the CARD Lab by monitoring trends and advances in technology, administering existing systems and databases, acquiring new software and hardware, developing methods, turning those methods into automated tools and systems, and providing training in tool and system use.

Function: 4.0 Manage Lab

Definition
Manage the overall operation of the CARD Lab, including budgets and funding, facilities and equipment, and personnel.


1.0 Provide Research & Services
F
1.1 Conduct Research
F
1.2 Provide Consulting Services
F

Function: 1.0 Provide Research & Services

Definition
Conduct research to advance the state of the art of anthropometry and to answer specific questions posed by, or in support of, other organizations, and provide anthropometric consulting services to other organizations.

Comments
The CARD Lab conducts research to advance methods for defining and representing the size, shape (summarization and characterization), strength, dexterity, and functional characteristics of humans for use in the design of clothing, personal protective equipment, and workstations.

Research studies may be focused on different parts of the human body (for example, head, hands, total body, etc.) or on the human-system interface.

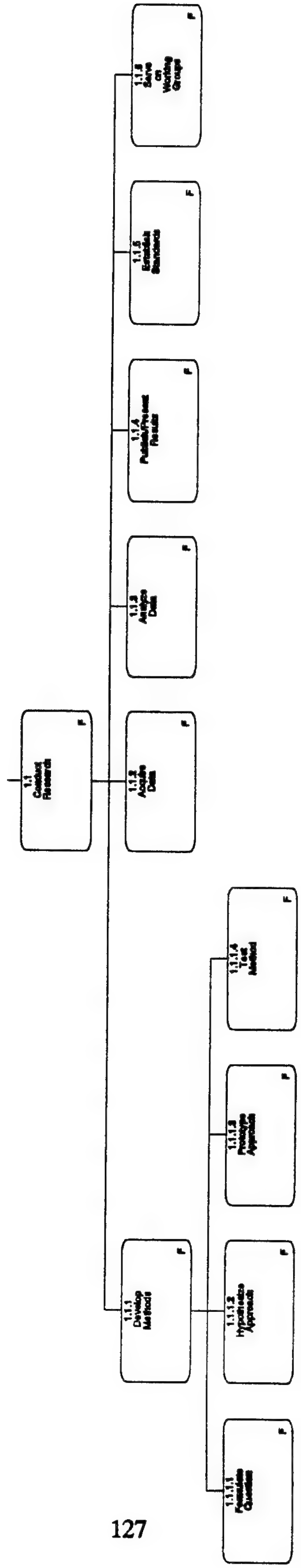
Research may be conducted for a specific sponsor or may be conducted as part of the research program of a member of the Lab staff.

Function: 1.1 Conduct Research

Definition
Advance the state of the art of engineering anthropometry by conducting research to develop or refine anthropometric techniques and methods, introducing new technologies into the discipline, delivering papers and presentations, and serving on working groups.

Function: 1.2 Provide Consulting Services

Definition
Provide anthropometric consulting services to Lab customers and funding agencies by participating in the procurement process and serving as an expert witness.


1.1
Conduct
Research
1.1.1
Develop
Method
1.1.2
Acquire
Data
1.1.3
Analyze
Data
1.1.4
Publish/Present
Results
1.1.5
Establish
Standards
1.1.6
Serve
on
Working
Groups
1.1.1.1
Formulate
Question
1.1.1.2
Hypothesize
Approach
1.1.1.3
Prototype
Approach
1.1.1.4
Test
Method

Function: 1.1 Conduct Research

Definition
Advance the state of the art of engineering anthropometry by conducting research to develop or refine anthropometric techniques and methods, introducing new technologies into the discipline, delivering papers and presentations, and serving on working groups.

Function: 1.1.1 Develop Methods

Definition
Develop new methods and techniques for assessing the fit (or accommodation) of clothing, personal protective equipment, cockpits, aircraft crewstations, and other work stations to the human body, or collecting anthropometric data. This involves formulating the research question, hypothesizing an approach to answer the question, prototyping and testing the approach.

Function: 1.1.1.1 Formulate Question

Definition
Formulate the research question necessary to satisfy the need of a Lab customer and to guide a research investigation. This research question may be documented in the form of a research proposal.

Function: 1.1.1.2 Hypothesize Approach

Definition
Design the research approach(method) necessary to answer the research question, plan the tests required to evaluate the approach, and document any applicable research protocols.

Function: 1.1.1.3 Prototype Approach

Definition
Develop prototypes of any required forms, equipment, etc. necessary to execute the research approach.

Function: 1.1.1.4 Test Method

Definition
Execute the test plan for the new method to evaluate the overall reliability, repeatability, and consistency of the new method and to compare the quality of measurements acquired through the use of traditional anthropometry with those acquired through the use of the new method. Modify the approach based on the results of the test.

Function: 1.1.2 Acquire Data

Definition
Acquire data on the human body, as well as other objects, and the fit/accommodation of clothing, personal protective equipment, cockpits, and aircraft crewstations.

Comments
Advancing anthropometry will involve collecting new data about:
* 3-dimensional surface and subsurface
* tissue properties
* strength and dexterity
* bio-mechanics and movement
* human-equipment interface

Function: 1.1.3 Analyze Data

Definition
Conduct analyses on the data necessary to answer the research questions. This may involve extracting data from population samples, manipulating 3-dimensional images, and/or running statistical or mathematical procedures against the data.

Function: 1.1.4 Publish/Present Results

Definition
Document and publish the research results in technical reports or through a briefing to inform the research sponsor of the results and

for subsequent use by Lab personnel and other organizations.

Function: 1.1.5 Establish Standards

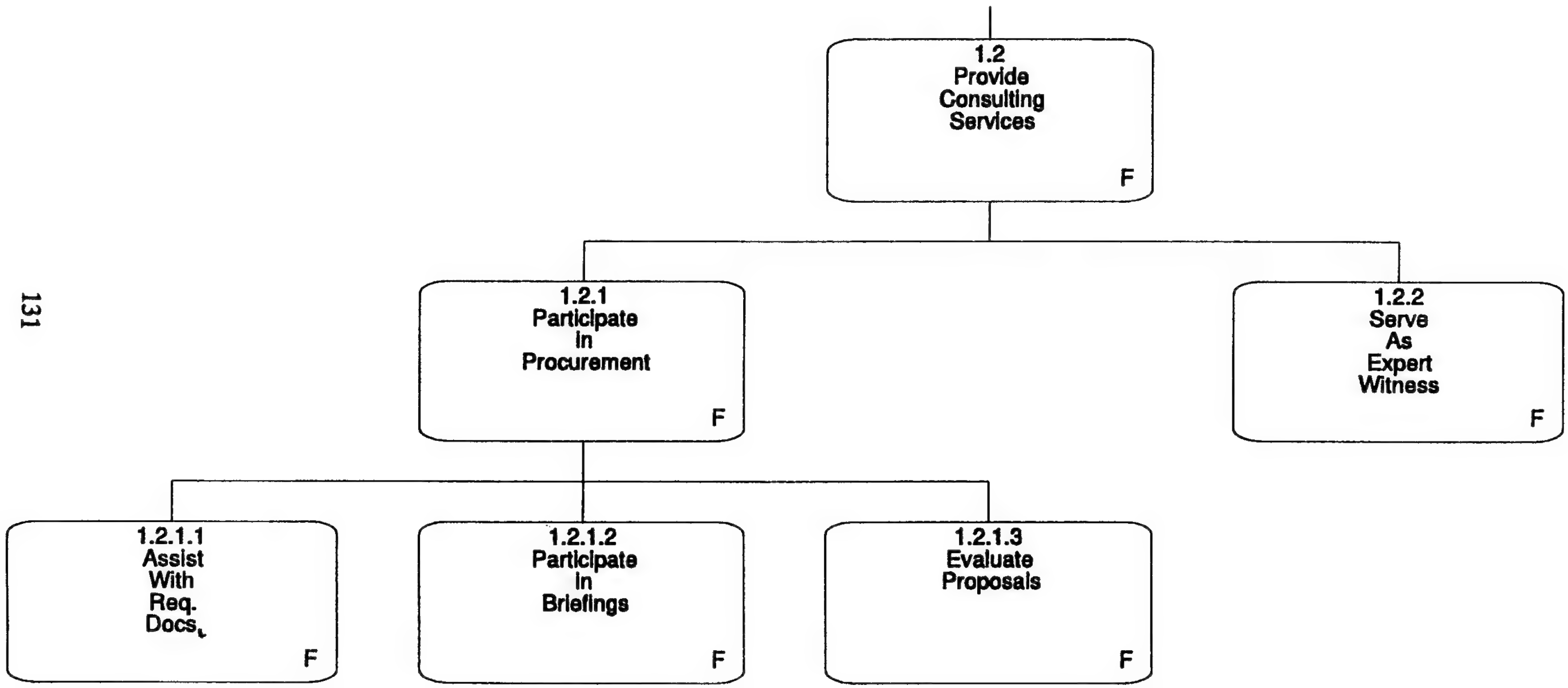
Definition
Establish and publish standards and/or handbooks to codify the new methods for the acquisition, storage, analysis, and exchange of anthropometric data on the human body and/or the human-equipment interface. These standards may be general in nature or application specific (fit or accommodation assessment, anthropometry, etc.).

Function: 1.1.6 Serve on Working Groups

Definition
Serve on national and international working groups, committees, and professional societies as a means of furthering engineering anthropometry, as a forum for information exchange for advanced methods and techniques, and as a means of promoting the CARD Lab.

Comments
Lab staff currently serve on the following working groups, committees, and professional societies:

* Electronic Imaging of the Human Body
* Working Group on Night Visions Systems
* Tri-Service Working Group for Bio-Mechanics
* Advisory Group for Aerospace Research and Development (AGARD)
* Air Standardization Coordinating Committee (ASCC)
* Defense Advisory Committee on Women in Services
* Human Factors Society
* Aerospace Medical Association
* SAFE


1.2
Provide
Consulting
Services
F
1.2.1
Participate
In
Procurement
F
1.2.2
Serve
As
Expert
Witness
F
1.2.1.1
Assist
With
Req.
Docs.
F
1.2.1.2
Participate
In
Briefings
F
1.2.1.3
Evaluate
Proposals
F

Function: 1.2 Provide Consulting Services

Definition
Provide anthropometric consulting services to Lab customers and funding agencies by participating in the procurement process and serving as an expert witness.

Function: 1.2.1 Participate in Procurement

Definition
Participate in the process of procuring clothing, protective equipment, and aircraft by providing expertise in sound anthropometric practices and data, and commenting on designs and proposals based on that expertise.

Function: 1.2.1.1 Assist With Req. Docs.

Definition
Provide assistance to SPOs and other acquiring agencies with the preparation of requirements documents, including requests for proposal, for clothing, personal protective equipment, and aircraft. Such assistance is aimed at incorporating sound anthropometric practices and data into the acquisition process.

Function: 1.2.1.2 Participate in Briefings

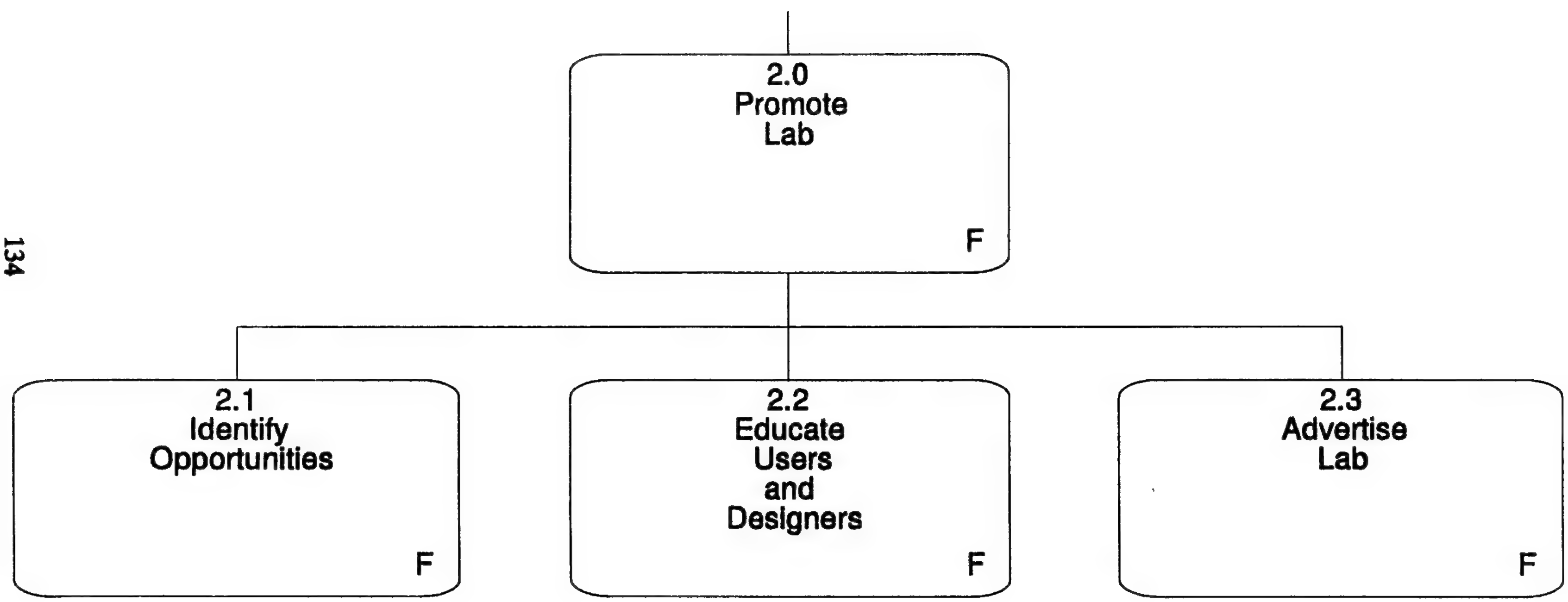
Definition
Provide expertise in engineering anthropometry during briefings with manufacturers to discuss the design of clothing, personal protective equipment, and aircraft.

Function: 1.2.1.3 Evaluate Proposals

Definition
Evaluate proposals from manufacturers of clothing, personal protective equipment, and aircraft based on the criteria of sound engineering anthropometry and data.

Function: 1.2.2 Serve As Expert Witness

Definition
Serve as an expert witness in engineering anthropometry, giving testimony and advice to Senate, Pentagon, and other Governmental committees.


2.0
Promote
Lab
F
2.1
Identify
Opportunities
F
2.2
Educate
Users
and
Designers
F
2.3
Advertise
Lab
F

Function: 2.0 Promote Lab

Definition
Promote the use of Lab research capabilities and data, as well as other anthropometric consulting services, and the benefits of using those services and data, by identifying opportunities for the application of Lab capabilities, educating engineers and designers in the use of Lab data and services, participating on working groups, and advertising.

Function: 2.1 Identify Opportunities

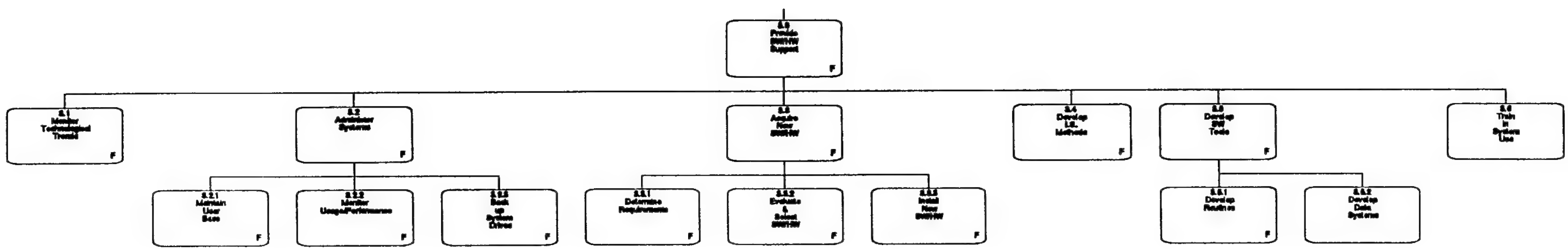
Definition
Search for and identify opportunities where the Lab's data and/or services could be applied to the design of an object so that the comfort, fit, safety, and performance of the object are improved.

Function: 2.2 Educate Users and Designers

Definition
Educate engineers, designers, representatives from acquiring agencies, and other interested parties on the role and value of engineering anthropometry and the access and use of Lab data and services.

Function: 2.3 Advertise Lab

Definition
Promote the capabilities of the CARD Lab through print advertising, video presentations, and public affairs publications, and by giving tours of the Lab facilities.


Provide
Support
Monitor
Technological
Trends
Administer
Systems
Maintain
User
Base
Monitor
Usage/Performance
Back
up
System
Drives
Acquire
New
Determine
Requirements
Evaluate
&
Select
Install
New
Develop
I.S.
Methods
Develop
SW
Tools
Develop
Routines
Develop
Data
Systems
Train
in
System
Use

Function: 3.0 Provide SW/HW Support

Definition
Provide computer software and hardware support for the CARD Lab by monitoring trends and advances in technology, administering existing systems and databases, acquiring new software and hardware, developing methods, turning those methods into automated tools and systems, and providing training in tool and system use.

Function: 3.1 Monitor Technological Trends

Definition
Monitor trends and advances in computer software and hardware technologies and software development methodologies to stay abreast of developments which might benefit the Lab.

Function: 3.2 Administer Systems

Definition
Administer existing computer software and hardware systems by maintaining user authorization and privileges, monitoring usage and performance, backing up databases, and in general managing the configuration of the overall system as well as system components, etc.

Function: 3.2.1 Maintain User Base

Definition
Maintain a database of Lab system users, including user addresses, security authorization, and access and use privileges for users within and outside the Lab.

Function: 3.2.2 Monitor Usage/Performance

Definition
Monitor the usage and performance of all system components -- hardware (computers, printers, etc.), application software, databases, network,

etc.

Function: 3.2.3 Back up System Drives

Definition
Back up all system disk drives on a regularly scheduled basis to ensure that databases and other software components can be recovered in the event of a system failure.

Function: 3.3 Acquire New SW/HW

Definition
Acquire new software and/or hardware by determining the requirements for software or hardware, evaluating commercial offerings against those requirements and selecting those best satisfying the requirements, and installing the software and/or hardware.

Function: 3.3.1 Determine Requirements

Definition
Determine the requirements for software or hardware to be acquired.

Function: 3.3.2 Evaluate & Select SW/HW

Definition
Evaluate software and/or hardware offerings and select those which best satisfy the Lab requirements.

Function: 3.3.3 Install New SW/HW

Definition
Install new software and/or hardware.

Function: 3.4 Develop I.S. Methods

Definition
Develop methods and techniques to guide the development and application

of information systems technologies in support of the Lab. This includes methods and standards for developing information systems, storing data and images in computer files, accessing the data and images, and presenting them for and performing visualization, manipulation, and analysis.

Comments
These methods might be used for modeling surface and subsurface data, merging surface and subsurface data into a consolidated image, and modeling bio-mechanical and movement data. These methods are turned into software applications in function 3.5.

Function: 3.5 Develop SW Tools

Definition
Provide software tools to support Lab operations by custom development of stand-alone routines as well as more comprehensive data systems.

Function: 3.5.1 Develop Routines

Definition
Develop stand-alone routines or modules to satisfy ad hoc requests or meet one-time or short-term needs for software support. Routines are frequently developed to support specific research efforts.

This function includes both new development and enhancement or modification of existing routines.

Program code is developed in a modular fashion to allow additional capabilities to be incorporated later.

Comments
Routines might support any of the following:
* automated landmarking
* display of an axis system for 3D head data
* visualization and manipulation of 3D images
* data reduction
* data exchange formats (between the CARD Lab Data

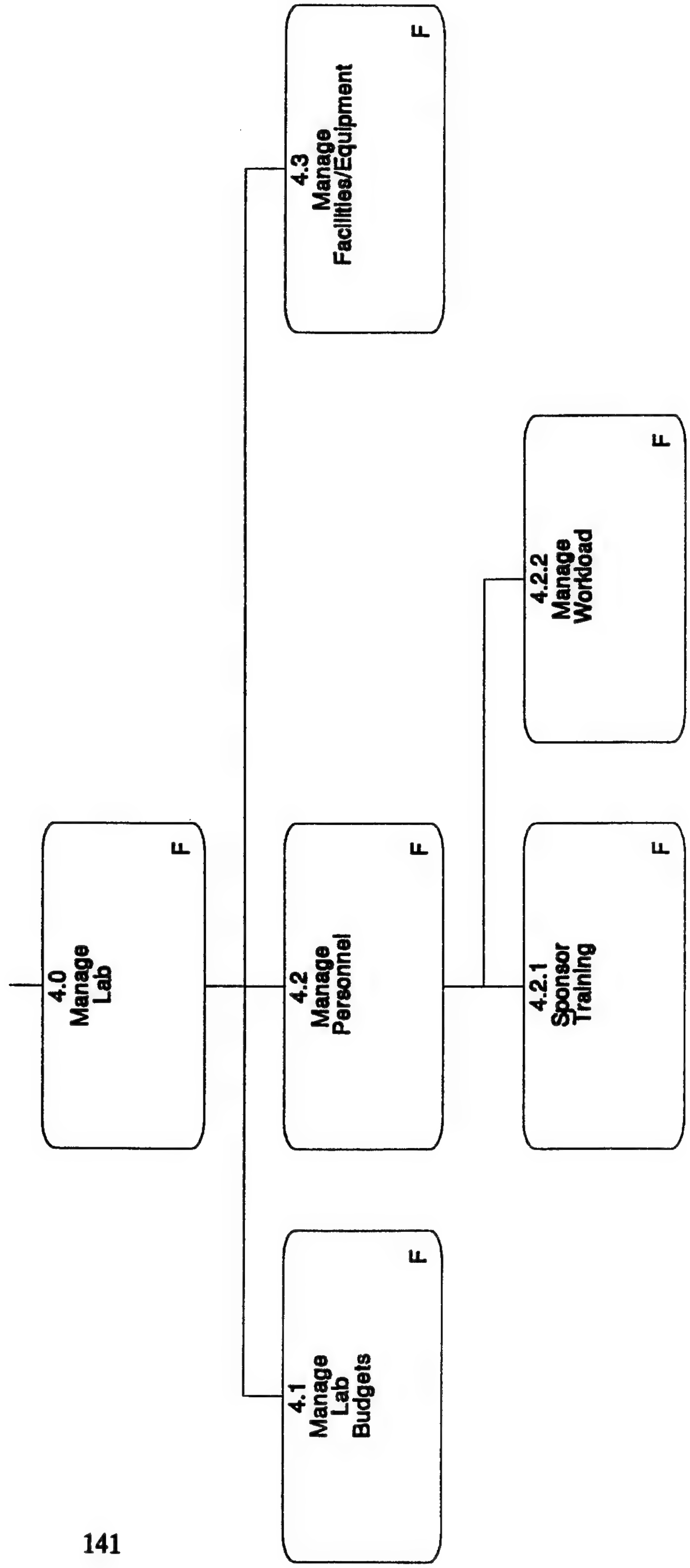
System and other systems, such as CAD and modeling, etc.)
* automated identification of colored points found on scanned objects.

Function: 3.5.2 Develop Data Systems

Definition
Develop complete data systems, including 2- and 3-dimensional databases, user interface, and programs, to meet multiple use or on-going needs for software support. This includes both new development and enhancement or modification of existing systems.

Function: 3.6 Train in System Use

Definition
Train Lab personnel, 3rd party systems developers, and other system users in the capabilities, access, and use of software. Provide on-going support for the use of Lab data and hardware/software tools.


4.0
Manage
Lab
F
4.1
Manage
Lab
Budgets
F
4.2
Manage
Personnel
F
4.3
Manage
Facilities/Equipment
F
4.2.1
Sponsor
Training
F
4.2.2
Manage
Workload
F

Function: 4.0 Manage Lab

Definition
Manage the overall operation of the CARD Lab, including budgets and funding, facilities and equipment, and personnel.

Function: 4.1 Manage Lab Budgets

Definition
Prepare budgets for the Lab, attract funding and sponsors for Lab projects, and manage contracts and expenditures against the budget.

Function: 4.2 Manage Personnel

Definition
Ensure that the personnel with appropriate training and skills are available to accomplish the projects and studies undertaken by the Lab, and manage the workload assigned to staff.

Function: 4.2.1 Sponsor Training

Definition
Sponsor training for Lab personnel, to help personnel stay current with technology, methods, and techniques.

Function: 4.2.2 Manage Workload

Definition
Manage the workload assigned to Lab personnel and coordinate project and study priorities across the Lab.

Function: 4.3 Manage Facilities/Equipment

Definition
Manage the facilities allocated to the Lab and the equipment owned by the Lab. This includes assigning workspace, arranging needed modifications and maintenance to lighting or layout, coordinating moves when necessary, etc.

APPENDIX E

DATABASE DESCRIPTION

RIM COCKPIT DATABASE SCHEMA

RELATION : AIRCRAFT

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
ANUM	INT	1	YES
CATNUM	INT	1	
ANAME	TEXT	8 CHARACTERS	

CURRENT NUMBER OF ROWS = 5

RELATION : AIRDESC

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
ANUM	INT	1	YES
ADESC	TEXT	VARIABLE	

CURRENT NUMBER OF ROWS = 0

RELATION : CATNAME

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
CATNUM	INT	1	
CATNAME	TEXT	10 CHARACTERS	

CURRENT NUMBER OF ROWS = 3

RELATION : CREWSTA

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
CREWSTAN	INT	1	YES
CREWSTA	TEXT	10 CHARACTERS	

CURRENT NUMBER OF ROWS = 4

RELATION : AIRCREW

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
ANUM	INT	1	YES
CREWSTAN	INT	1	YES

CURRENT NUMBER OF ROWS = 9

RELATION : AIRREG

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
ANUM	INT	1	YES
REGNUM	INT	1	

CURRENT NUMBER OF ROWS = 35

RELATION : CONTROL

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
CONTNUM	INT	1	YES
CONTNAME	TEXT	60 CHARACTERS	

CURRENT NUMBER OF ROWS = 281

RELATION : CREWCONT

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
ANUM	INT	1	YES
CREWSTAN	INT	1	YES
CONTNUM	INT	1	YES

CURRENT NUMBER OF ROWS = 407

RELATION : SEATADJ

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
ANUM	INT	1	YES
ADJDIR	TEXT	1 CHARACTERS	
ADJINC	REAL	1	
MAXADJ	REAL	1	

CURRENT NUMBER OF ROWS = 7

RELATION : REACH

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
ANUM	INT	1	YES
REGNUM	INT	1	
CREWSTAN	INT	1	YES
CONTHAND	TEXT	1 CHARACTERS	YES
CONTNUM	INT	1	YES
CONTTYPE	TEXT	1 CHARACTERS	
MEASURED	TEXT	1 CHARACTERS	
Z2FACTOR	REAL	1	
SHSCOEF	REAL	1	
CONSTANT	REAL	1	

CURRENT NUMBER OF ROWS = 474

RELATION : RCHNOTE

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
ANUM	INT	1	YES
REGNUM	INT	1	
CREWSTAN	INT	1	YES
CONTHAND	TEXT	1 CHARACTERS	YES

CONTNUM	INT	1	YES
RNOTENUM	INT	1	

CURRENT NUMBER OF ROWS = 0

RELATION : VIEW
LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
VIEWNUM	INT	1	YES
VIEW	TEXT	60 CHARACTERS	

CURRENT NUMBER OF ROWS = 6

RELATION : CREWVIEW
LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
ANUM	INT	1	YES
CREWSTAN	INT	1	YES
VIEWNUM	INT	1	YES

CURRENT NUMBER OF ROWS = 31

RELATION : VISNOTE
LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
ANUM	INT	1	YES
VIEWNUM	INT	1	YES
HEADPOSN	INT	1	YES
CREWSTAN	INT	1	YES
VNOTENUM	INT	1	

CURRENT NUMBER OF ROWS = 16

RELATION : CLRTITLE
LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
TITLENUM	INT	1	YES
TITLE	TEXT	60 CHARACTERS	
MIN	TEXT	1 CHARACTERS	

CURRENT NUMBER OF ROWS = 5

RELATION : CREWTITL
LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
ANUM	INT	1	YES
CREWSTAN	INT	1	YES
TITLENUM	INT	1	YES
FMTTYPE	INT	1	

CURRENT NUMBER OF ROWS = 32

RELATION : TYPETWO

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
ANUM	INT	1	YES
TITLENUM	INT	1	YES
CREWSTAN	INT	1	YES
LINEMNUM	INT	1	
LINEMVAL	REAL	1	
MNUM	INT	1	
LOWVAL	REAL	1	
LOWCLR	REAL	1	
UPVAL	REAL	1	
UPCLR	REAL	1	
DEGSUBT	REAL	1	

CURRENT NUMBER OF ROWS = 2

RELATION : CLRNOTE

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
ANUM	INT	1	YES
TITLENUM	INT	1	YES
CREWSTAN	INT	1	YES
CNOTENUM	INT	1	

CURRENT NUMBER OF ROWS = 10

RELATION : MNAME

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
MNUM	INT	1	
MNAME	TEXT	35 CHARACTERS	

CURRENT NUMBER OF ROWS = 4

RELATION : LINEMNAM

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
LINEMNUM	INT	1	
LINEMNAM	TEXT	35 CHARACTERS	

CURRENT NUMBER OF ROWS = 1

RELATION : REGION

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
REGNUM	INT	1	
REGION	TEXT	30 CHARACTERS	

CURRENT NUMBER OF ROWS = 12

RELATION : VNOTE

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
VNOTENUM	INT	1	
VNOTE	TEXT	120 CHARACTERS	

CURRENT NUMBER OF ROWS = 1

RELATION : CNOTE

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
CNOTENUM	INT	1	
CNOTE	TEXT	120 CHARACTERS	

CURRENT NUMBER OF ROWS = 5

RELATION : RNOTE

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
RNOTENUM	INT	1	
RNOTE	TEXT	120 CHARACTERS	

CURRENT NUMBER OF ROWS = 0

RELATION : VISION

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
ANUM	INT	1	YES
VIEWNUM	INT	1	YES
HEADPOSN	INT	1	YES
CREWSTAN	INT	1	YES
MINEHT	REAL	1	
MINVDEG	REAL	1	
MAXEHT	REAL	1	
MAXVDEG	REAL	1	
ABVGLARE	REAL	1	
GLAREHT	REAL	1	
BLWGLARE	REAL	1	

CURRENT NUMBER OF ROWS = 60

RELATION : CREWREG

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
ANUM	INT	1	YES
CREWSTAN	INT	1	YES
REGNUM	INT	1	

CURRENT NUMBER OF ROWS = 58

RELATION : VISADJ

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
ANUM	INT	1	YES
VIEWNUM	INT	1	YES
HEADPOSN	INT	1	YES
CREWSTAN	INT	1	YES
ADJDEG	REAL	1	

CURRENT NUMBER OF ROWS = 16

RELATION : TYPEONE

LAST MOD : 93/03/04 READ PASSWORD : NONE
SCHEMA : CACCOM MODIFY PASSWORD : NONE

NAME	TYPE	LENGTH	KEY
ANUM	INT	1	YES
TITLENUM	INT	1	YES
CREWSTAN	INT	1	YES
SEATPOS	INT	1	
MNUM	INT	1	
MVAL	REAL	1	
CLRCHNG	REAL	1	

CURRENT NUMBER OF ROWS = 58

RIM COCKPIT DATABASE DATA

RELATION: AIRCRAFT

ANUM	CATNUM	ANAME
1	1	F-16A
2	2	C-141A
3	3	T-37B
4	3	T-38A
5	3	T-1A

RELATION: AIRDESC

ANUM	ADESC

RELATION: CATNAME

CATNUM	CATNAME
1	FIGHTER
2	CARGO
3	TRAINER

RELATION: CREWSTA

CREWSTAN	CREWSTA
1	LEFT
2	RIGHT
3	FORWARD
4	AFT

RELATION: AIRCREW

ANUM	CREWSTAN
1	3
2	1
2	2
3	1
3	2
4	3
4	4
5	1
5	2

RELATION: AIRREG

ANUM	REGNUM
1	1
1	2
1	3
1	4

1	5
1	6
2	1
2	2
2	3
2	4
2	5
2	6
2	7
2	8
2	10
3	3
3	4
3	8
3	11
3	12
4	1
4	2
4	3
4	4
4	5
4	6
4	9
4	11
4	12
5	3
5	4
5	7
5	8
5	10
5	11

RELATION: CONTROL

CONTNUM	CONTNAME
80	AC-FUSES-LOWERMOST-RT
100	AC-FUSES-UPPERMOST-RT
130	ACCELEROMETER-PUSH-TO-RESET-KNOB
145	ADF-CONTRL-TRF-2
148	ADF-VOL-LT
157	ADI-LT
202	AERIAL-REFUEL-LTS
310	AHRS-BATT-TEST
322	AILERON-TRIM-LOWER
327	AIMS-CONTRL-PANEL-MASTER-KNOB
332	AIR-CONTRL-KNOB-RT
333	AIR-CONTRL-KNOB-LT
339	AIR-REFUEL-OPN-CLO
341	AIRSPD-MACH-IND
342	AIRSPD-MACH-IND-LT
343	AIRSPD-MACH-IND-MACH-SLEW-TOGG-RT
373	ALTIMETER-ADJUSTMENT-KNOB
400	ALTIMETER-ALT-SEL-LT
442	ALTIMETER-SEL-KNOB
444	ALTIMETER-SET-KNOB
445	ALTITUDE-VERT-VEL-IND-SLEW-TOGG-RT
446	ALTITUDE-VERT-VEL-IND-SLEW-TOGG-LT
482	AN-APX-72-TRANSPONDER-CONTRL-PANEL-MASTER-SWTCH
519	ANNUNCIATOR
522	ANTENNA-SEL-UHF
523	ANTI-COLLISION-BEACON-LTS-SWTCH
525	ANTI-G-TEST
528	ANTI-SKID-TOGG

700	AOA-INDEXER-LIGHTS-DIMMER
871	AUTO-PILOT-TURN
900	AUX-GEAR-CONTRL
2040	BAILOUT-ALARM
2100	BATTERY-SWTCH
2157	BDHI-SET-INDX-LT
2160	BDHI-VOR-2-LT
2280	BOOST-PUMP-LT-SWTCH
2281	BOOST-PUMP-RT-SWTCH
2411	BOT-2-ARM
2663	BRAKE-PRESSURE-NORM-EMERG
2665	BRAKE-T-HANDLE
2862	CABIN-AIR-OV-HT-ANNUNCIATOR
2864	CABIN-AIR-TEMP-SWTCH
2866	CABIN-CONTROLLER
2870	CABIN-DUMP
2917	CABIN-PRESSURE-SWTCH-RAM-DUMP
2944	CABIN-TEMP-CONTRL-KNOB
2971	CAGING-SWTCH
2998	CANOPY-DE-CLUTCH-T-HANDLE
3025	CANOPY-DEFOG-KNOB
3061	CANOPY-JETTISON-T-HANDLE
3062	CANOPY-LOCKING-LEVER
3065	CARGO-DOORS-ALL-DOORS
3280	CHUTE-REL-EMERG
3282	CHUTE-REL-REL-OFF
3301	CIRCUIT-BREAKER-PANEL-ARC-164
3320	CIRCUIT-BREAKER-PANEL-CAUTION-WARNING
3339	CIRCUIT-BREAKER-PANEL-XMTR-1
3430	CLOCK-PUSH-HARD
3490	CLOCK-SET-BUTTON
3554	CO-PILOT-NAV-SEL-PN-SEL-NORM
3559	CO-PILOT-SIDE-CONSOLE-LTS
3562	COCKPIT-AIR-LEVER
3565	COCKPIT-AIR-TEMP-CONTRL-RHEOSTAT
3568	COCKPIT-AIR-TEMP-CONTRL-SWTCH
3571	COMM-ANTENNA-SWTCH
3576	COMM-PANEL-NAV-2-RT
3580	COMM-PANEL-UHF-LT
3584	COMMAND-AND-NAV-O'RIDE-SWTCH
3588	COMPASS-SWTCH
3594	CONTRL-GRIP
3595	CONTRL-STICK-FULL-FWD-LT
3596	CONTRL-STICK-GRIP-LT-COCKPIT-FULL-FWD-LT
3597	CONTRL-STICK-GRIP-LT-COCKPIT-NEUTRAL
3598	CONTRL-STICK-NEUTRAL
3599	COURSE-SEL
3600	CONTRL-STICK-GRIP-RT-COCKPIT-FULL-FWD-LT
3601	CONTRL-STICK-GRIP-RT-COCKPIT-NEUTRAL
3605	CONTRL-YOKE-FULL-FWD-LT
3606	CONTRL-YOKE-FULL-FWD-RT
3610	CONTRL-YOKE-NEUTRAL-LT
3611	CONTRL-YOKE-NEUTRAL-RT
3615	COORDINATED-TURN-THUMB-WHEEL
3700	CROSSFEED-SWTCH
3884	CLIMB-DIVE-PULL-TO-CAGE
4000	CRS-OFF-VOR-LOC-L-NAV-LT
4001	CRS-OFF-VOR-LOC-L-NAV-RT
4056	DC-CIRCUIT-BREAKERS-LOWERMOST-RT
4112	DC-CIRCUIT-BREAKERS-UPPERMOST-RT
4170	DEFOG-LEVER
4254	DIGITAL-CLOCK-TIME-SWTCH-RT
4339	DIS/LTS
4439	DISP-DIM-PANEL-AIR-DATA-RT
4489	DISP-DIMMING-SWTCH-EADI-LT
4541	DOWNLOCK-O'RIDE-BUTTON

4594	DOWNLOCK-REL
5190	EEC-OFF-BUC
5247	EFIS-NAV-COMM-PANELS-LOWER-LT-SCREW
5252	EFIS-NAV-COMM-PANELS-LOWER-RT-SCREW
5257	EFIS-NAV-COMM-PANELS-UPPER-LT-SCREW
5262	EFIS-NAV-COMM-PANELS-UPPER-RT-SCREW
5340	LT-EJECTION-SEAT-HAND-GRIPS
5341	RT-EJECTION-SEAT-HAND-GRIPS
5418	ELEC-PITCH-TRIM-NOSE
5429	EMERG-BRAKE
5463	EMERG-CABIN-DEPRESS-T-HANDLE
5464	EMERG-DOOR-CLOSE
5465	EMERG-OXY-SHUT-OFF
5467	EMERG-PRESS-LH-TOGG
5469	EMERG-STORES-JETTISON
5470	EMERG-OXY-LEVER-LT
5471	EMERG-OXY-LEVER-RT
5475	ENGINE-ANTI-ICE-SWTCH
5480	ENGINE-FIRE-BELL-OFF
5490	ENGINE-FIRE-DETECT-SWTCH
5507	ENGINE-FIRE-TEST-4
5611	ENGINE-START-BUTTON-L
5715	ENGINE-START-LT
5720	ENGINE-START-RT
5926	EXT-CANOPY-CIRCUIT-SWTCH
6132	EXT-CANOPY-SWTCH
6339	FIRE-EXTINGUISH-T-HANDLE-1
6343	FIRE-EXTINGUISH-T-HANDLE-4
6347	FIRE-OVERHEAT-DETECT
6382	FLAPS
6418	FLAPS-LANDING-AFT
6518	FUEL-BOOST-PUMP-SWTCH
6618	FUEL-GAGING-SEL-SWTCH
6718	FUEL-OXY-CHECK-SWTCH
6847	FUEL-QUANT-SEL
6848	FUEL-QUANTITY-IND-TEST-SWTCH
6849	FUEL-SHUTOFF-SWTCH-L
6850	LT-FUEL-SHUTOFF-T-HANDLE
6851	RT-FUEL-SHUTOFF-T-HANDLE
6852	FUEL-X-FEED-L-TANK-NORM-R-TANK
6853	FUEL-SYSTEM-SWTCH
6857	FWD-CIRCUIT-BRKR-PANEL-F-H-INST
7023	GEAR-AUDIBLE-SILENCE-SWTCH
7190	GEAR-UP-WARNING
7440	LT-GENERATOR-SWTCH
7690	RT-GENERATOR-SWTCH
7940	GENERATOR-SWTCHES
8190	HEAD-UP-DISP-FILTER
8193	HEAD-UP-DISP-MILS-DEPR
8323	HEADING-IND-CUTOUT-&-FAST-SLAVE-SWTCH
8450	HORIZ-STAB-DE-ICE-BACKUP-MAN-NORM
8708	HSI-COURSE-SET-KNOB
8709	HSI-COURSE-SET-KNOB-LT
8710	HSI-COURSE-SET-KNOB-RT
8714	HSI-HEADING-SET-KNOB
8715	HSI-HEADING-SET-KNOB-RT
8717	HSI-PULL-TO-CAGE
9041	HYD-LEVEL-LO-ANNUNCIATOR
9046	HYDRAULIC-PRESS-SWTCH-REL-NORM
9216	IFF-IDENT
9218	IFF-ON-OUT
9246	IGNITION-LT-STBY-ON-OFF
9286	LT-IGNITION-SWTCH
9326	RT-IGNITION-SWTCH
9366	ILS-CONTRL-PANEL-FREQ-KNOB
9406	ILS-CONTRL-PANEL-POWER

9442	ILS-VOL
9480	INERTIA-REEL-LOCK-LEVER
9519	INSTR-PWR-TOGG
9520	INTERCOM-SWTCH-COMM
9521	INTERCOM-SWTCH-ILS
9522	INTERCOM-VHF-2-RT
9523	INTERCOM-SWTCH-INTER
9524	INTERCOM-SWTCH-NAV
9863	INVERTER-SWTCH
10202	JET-FUEL-START-2
10811	LANDING-&-TAXI-LTS-SWTCH
11420	LANDING-GEAR-ALT-REL-HANDLE
12030	LANDING-GEAR-DOWNLOCK-REL
12033	LANDING-GEAR-EMERG-O'RIDE-SWTCH-LT
12034	LANDING-GEAR-EMERG-O'RIDE-SWTCH-RT
12036	LANDING-GEAR-EMERG-T-HANDLE
12040	LANDING-GEAR-HANDLE
12041	LANDING-GEAR-HANDLE-LT
12042	LANDING-GEAR-HANDLE-RT
12045	LANDING-GEAR-LEVER
12058	LANDING-GEAR-WARNING-LIGHT-SIL-BUTTON
12071	LANDING-GEAR-WARNING-LIGHT-TEST-SWTCH
12084	LANDING-TAXI-LIGHT-SWTCH
12100	LH-ENGINE-FIRE-PUSH
12133	LIGHTING-CONTRL-PANEL-COCKPIT-FLOOD-KNOB
12166	LIGHTING-CONTRL-PANEL-WARNING-TEST-SWTCH
12200	LO-FILTER-BYPASS-ANNUNCIATOR
12610	LOBING-SWTCH
13020	MACH-INCREASE-TOGG
13025	MACH-KNOTS-SLEW-LEVER-LT
13040	MAIN-PWR-BATT
13045	MAL-AND-IND-LTS
13060	MANUAL-PITCH-O'RIDE
13065	MASTER-CAUTION-LIGHT
13700	MASTER-CAUTION-RESET-LT
13701	MASTER-CAUTION-RESET-RT
13750	MASTER-GENERATOR-L-GEN
13973	MENU-DISP-AVIONICS-STATUS
13993	MENU-DISP-FMS
14193	NAV-DME-CONTRL-PANEL-SELOR-SWTCH
14393	NAV-MODE-SWTCH-TACAN
14594	NOSEWHEEL-STEERING
15044	OVERHEAT-DETECT-SWTCH
15494	OXY-DILUTER-LEVER-LT
15495	OXY-DILUTER-LEVER-RT
15964	OXY-REG-FLOW-EMERG-NORM-LT
15966	OXY-SEL-SWTCH-NORM-OXY-MASK-LT
15967	OXY-SUPP-100%-NORM
15968	OXY-SUPP-LEVER-LT
15969	OXY-SEL-SWTCH-NORM-OXY-MASK-RT
15970	OXY-SUPP-ON-OFF-RT
15971	OXY-SUPP-LEVER-RT
15984	OXY-SUPPLY-SWTCH-100%-NORM
15998	OXY-SUPPLY-SWTCH-EMERG-NORM-TEST
16012	OXY-SUPPLY-SWTCH-ON-OFF
16026	PARKING-BRAKE
16322	PILOT-NAV-SEL-PANEL-COMPUTERS-NAV
16332	PILOT-SIDE-CONSOLE-LTS
16339	PITCH-ALT-HOLD
16343	PITCH-TRIM
16344	PITCH-TRIM-LT
16623	PITOT-HEAT-SWTCH
16903	POSITION-LTS-SWTCH
17183	PRESS-TO-TEST-SWTCH-FOR-LIGHT-IN-LT-FUEL-SHUTOFF-T-HANDLE
17184	PRESS-TO-TEST-SWTCH-FOR-LIGHT-IN-RT-FUEL-SHUTOFF-T-HANDLE
17463	PRIMARY-FLIGHT-INSTRS-LTS-RHEOSTAT-AFT

17743	PRIMARY-FLIGHT-INSTRS-LTS-RHEOSTAT-FWD
18020	RADAR-L-BAR
18030	RADIO-ALTIMETER-RESET
18123	RADIO-LTS-RHEOSTAT
18216	RADIO-TRANSFER-SWTCH-COMM
18309	RADIO-TRANSFER-SWTCH-NAV
18400	RH-ENGINE-FIRE-PUSH
18450	RO-FILTER-BYPASS-ANNUNCIATOR
18847	RUDDER-ARM
18850	RUDDER-HI-PRESSURE-O'RIDE
18851	RUDDER-PEDAL-ADJUST-T-HANDLE
18853	RUDDER-TRIM-NOSE
19024	SEAT-ADJUST-SWTCH
19196	SEL-JETTISON
19274	SHIFT-MULTI-FUNCTION-DISP
19444	SMOKE-HORN-OFF
19630	SPOILER-AUTO-RETRACT
19759	STALL-PREVENT-PILOT
19762	STALL-PREVENT-TEST-RT
19765	STALL-PREVENT-TEST-MACH-TEST
19766	STANDBY-PWR
19767	STANDBY-ATTITUDE-IND
19768	STARTER-1
19771	STARTER-4
19774	STARTER-SWTCH-LT
19777	STARTER-SWTCH-RT
19780	STEERING-MODE-SWTCH-NORM-MANUAL
19784	STORAGE-CONFIG-CAT-1
19859	SUIT-PRESSURE
19914	TACAN-CONTRL-PANEL-A/A-T/R
19969	TACAN-CONTRL-PANEL-CHANNEL-KNOB
20020	TACAN-A/A-T/R-RT
20025	TACAN-HEADING
20085	TEMP-CONTRL-PANEL-MAN-PRESS-CNTRL
20134	THROTTLE-FRICTION-KNOB
20280	THROTTLE-FWD-LT
20281	THROTTLE-FWD-RT
20282	THROTTLE-FWD
20572	THRUST-REVERSE-LIMITER
20669	TRIM-RESET-TOGG
20819	UHF-COMMAND-RADIO-AN-ARC-164-PANEL-PRESET-SWTCH
20969	UHF-COMMAND-RADIO-CONTRL-PANEL-MAIN
21119	UHF-COMMAND-RADIO-CONTRL-PANEL-PRESET
21268	UHF-PRESET
21735	UHF-VHF-PA-SWTCH-LT
21745	UHF-VHF-PA-SWTCH-NOT-VOL-RT
22202	VERT-SCALE-FLT-INSTR-IAS
22205	VERT-SCALE-IAS-NORM
22305	VIDEO-SEL
22747	WARNING-LIGHT-DIMMING-SWTCH
23190	WEATHER-RADAR-SLEW-TOGG
23264	WINDSHIELD-CANOPY-DEFROST-KNOB
23339	WINDSHIELD-HEAT
25060	YAW-DAMPER-ON-OFF
25065	YAW-DAMPER-TEST

RELATION: CREWCONT

ANUM	CREWSTAN	CONTNUM
1	3	202
1	3	339
1	3	341
1	3	442

1	3	522
1	3	525
1	3	3061
1	3	3594
1	3	3599
1	3	4339
1	3	4594
1	3	5190
1	3	5469
1	3	6347
1	3	6847
1	3	8190
1	3	8193
1	3	8717
1	3	9216
1	3	9442
1	3	10202
1	3	13040
1	3	13045
1	3	13060
1	3	13065
1	3	15967
1	3	16339
1	3	16343
1	3	18020
1	3	18847
1	3	19196
1	3	19274
1	3	19784
1	3	19859
1	3	20025
1	3	20282
1	3	21268
1	3	22305
2	1	145
2	1	148
2	1	157
2	1	322
2	1	446
2	1	528
2	1	2040
2	1	2157
2	1	2160
2	1	2665
2	1	3065
2	1	3282
2	1	3339
2	1	3559
2	1	5463
2	1	5465
2	1	5467
2	1	5507
2	1	6339
2	1	6343
2	1	6418
2	1	8709
2	1	9519
2	1	12040
2	1	13020
2	1	13025
2	1	14594
2	1	15964
2	1	16322
2	1	16332
2	1	16344
2	1	18850

2	1	18853
2	1	19759
2	1	19765
2	1	19768
2	1	19771
2	1	20280
2	1	20572
2	1	20669
2	1	22202
2	1	23190
2	1	23339
2	1	25065
2	2	322
2	2	343
2	2	445
2	2	519
2	2	871
2	2	2040
2	2	2663
2	2	3280
2	2	3430
2	2	3554
2	2	3559
2	2	5418
2	2	5463
2	2	5507
2	2	6339
2	2	6343
2	2	7190
2	2	8710
2	2	8715
2	2	9218
2	2	9522
2	2	12040
2	2	15970
2	2	18850
2	2	18853
2	2	19630
2	2	19759
2	2	19762
2	2	19768
2	2	19771
2	2	20020
2	2	20281
2	2	22205
2	2	25060
3	1	80
3	1	100
3	1	130
3	1	333
3	1	373
3	1	482
3	1	523
3	1	2100
3	1	2971
3	1	3061
3	1	3562
3	1	3565
3	1	3568
3	1	3596
3	1	3597
3	1	4056
3	1	4113
3	1	5340
3	1	5470
3	1	5490

3	1	6518
3	1	6618
3	1	6848
3	1	6850
3	1	6851
3	1	6853
3	1	7023
3	1	7440
3	1	7690
3	1	8323
3	1	9286
3	1	9326
3	1	9863
3	1	10811
3	1	12033
3	1	12036
3	1	12041
3	1	12042
3	1	12071
3	1	12610
3	1	14193
3	1	15044
3	1	15494
3	1	15968
3	1	16623
3	1	16903
3	1	17183
3	1	17184
3	1	17463
3	1	17743
3	1	18123
3	1	19774
3	1	19777
3	1	20134
3	1	20280
3	1	20281
3	1	20819
3	1	22747
3	1	23264
3	2	80
3	2	130
3	2	332
3	2	373
3	2	482
3	2	523
3	2	2100
3	2	2971
3	2	2998
3	2	3061
3	2	3562
3	2	3565
3	2	3568
3	2	3600
3	2	3601
3	2	4056
3	2	5341
3	2	5471
3	2	5490
3	2	5926
3	2	6132
3	2	6518
3	2	6618
3	2	6848
3	2	6850
3	2	6851
3	2	6853

3	2	7023
3	2	7440
3	2	7690
3	2	8323
3	2	9286
3	2	9326
3	2	9863
3	2	10811
3	2	12034
3	2	12036
3	2	12041
3	2	12042
3	2	12071
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3	2	14193
3	2	15044
3	2	15495
3	2	15971
3	2	16623
3	2	16903
3	2	17183
3	2	17184
3	2	17463
3	2	17743
3	2	18123
3	2	19774
3	2	19777
3	2	20281
3	2	20819
3	2	22747
3	2	23264
4	3	327
4	3	341
4	3	444
4	3	700
4	3	2100
4	3	2280
4	3	2281
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4	3	2944
4	3	3025
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4	3	3062
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4	3	6849
4	3	7940
4	3	8708
4	3	8714
4	3	9366
4	3	9406
4	3	9480
4	3	9520
4	3	9521
4	3	11420

4	3	12045
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4	3	12084
4	3	12133
4	3	13065
4	3	14393
4	3	15984
4	3	15998
4	3	16012
4	3	16623
4	3	18216
4	3	18309
4	3	18851
4	3	19024
4	3	19767
4	3	19780
4	3	19914
4	3	19969
4	3	20282
4	3	20969
4	3	21119
4	4	341
4	4	444
4	4	700
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4	4	3584
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4	4	9406
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4	4	9521
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4	4	9524
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4	4	12058
4	4	12133
4	4	12166
4	4	13065
4	4	14393
4	4	15984
4	4	15998
4	4	16012
4	4	18851
4	4	19024
4	4	19767
4	4	19780
4	4	19914
4	4	19969
4	4	20282
4	4	20969
4	4	21119
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5	1	400
5	1	900
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5	1	13700
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5	1	19444
5	1	20085
5	1	20282
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5	2	900
5	2	2411
5	2	2862
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5	2	5715
5	2	6382
5	2	6852
5	2	9246
5	2	12030
5	2	12045
5	2	12100
5	2	12200
5	2	13701

5	2	13750
5	2	13973
5	2	15969
5	2	19766
5	2	20085
5	2	20282
5	2	21745

RELATION: SEATADJ

ANUM	ADJDIR	ADJINC	MAXADJ	
1	V	1.	5.	
2	V	1.	5.	
2	H	.75	7.5	
3	V	.625	5.	
4	V	1.	5.	
5	V	.75	4.5	
5	H	.75	7.75	7.5

ADJUSTED APRIL 1993 TO
ACCOMMODATE MEASUREMENTS
TO .10

ADD ATTRIBUTE JUNE 1993
ADJTYPE,
WHERE 0=NOTCHES
I=INCHES

RELATION: REACH

ANUM	REGNUM	CREWSTAN	CONTHAND	CONTNUM	CONTTYPE	MEASURED	Z2FACTOR	SHSCOEF	CONSTANT
1	6	3	R	202	T	Y	2.3	.4660105	15.802
1	1	3	L	339	F	Y	2.2	.4168444	16.70999
1	3	3	L	341	T	Y	4.3	.086521	35.59789
1	3	3	L	442	F	Y	4.3	-.275956	44.30863
1	6	3	R	522	F	Y	2.3	.4131456	16.23662
1	1	3	L	525	F	Y	2.2	.7928217	10.03991
1	1	3	L	3061	T	Y	2.2	1.200466	1.835198
1	6	3	R	3594	G	Y	2.3	.5774135	14.77916
1	4	3	L	3599	T	Y	4.3	.3715847	29.16798
1	3	3	L	4339	T	Y	4.3	.428051	27.58007
1	2	3	L	4594	F	Y	3.6	-.114754	33.80606
1	1	3	L	5190	F	Y	3.6	.1985428	24.2922
1	2	3	L	5469	F	Y	3.6	-.249545	38.39493
1	1	3	L	6347	F	Y	2.2	.6785064	13.70501
1	5	3	R	6847	T	Y	2.3	.0655738	33.52082
1	5	3	L	6847	T	Y	4.3	.5245902	31.57656
1	3	3	L	8190	T	Y	4.3	-.007286	33.68102
1	3	3	L	8193	T	Y	4.3	-.275046	41.2485
1	3	3	L	8717	T	Y	4.3	-.080146	41.62122
1	3	3	L	9216	F	Y	3.6	-.098361	35.62377
1	6	3	R	9442	T	Y	2.3	.2723133	25.68188
1	1	3	L	10202	T	Y	3.6	.37796	22.93709
1	1	3	L	13040	T	Y	2.2	.5446267	16.10375
1	6	3	R	13045	F	Y	2.3	.5737704	13.77967
1	1	3	L	13060	F	Y	3.6	.2030965	26.46157
1	3	3	L	13065	F	Y	4.3	.4887335	20.13271
1	6	3	R	15967	F	Y	2.3	.003643	25.14949
1	3	3	L	16339	F	Y	3.6	-.104736	35.24466
1	1	3	L	16343	F	Y	2.2	.4084507	16.15211
1	1	3	L	18020	F	Y	3.6	.287796	23.88971
1	1	3	L	18847	T	Y	2.2	.8926795	8.735253
1	3	3	L	19196	F	Y	4.3	-.003643	35.99051
1	3	3	L	19274	F	Y	4.3	.1602914	31.89756
1	2	3	L	19784	F	Y	3.6	.0473588	30.36337
1	6	3	R	19859	F	Y	2.3	.1338798	26.61126
1	4	3	L	20025	T	Y	4.3	.3296904	28.64384
1	1	3	L	20282	H	Y	3.6	.3715847	21.81798
1	1	3	L	21268	T	Y	3.6	.3952641	20.03466

1	1	3	L	22305	F	Y	2.2	.6059944	11.45252
2	4	1	R	145	F	Y	3.7	.2449045	26.28081
2	4	1	R	148	T	Y	3.7	.3377105	21.77775
2	3	1	R	157	T	Y	4.2	.3770241	25.66256
2	4	1	R	322	T	Y	3.9	.0565536	28.27939
2	3	1	R	446	F	Y	4.2	.4836059	21.51217
2	3	1	R	528	F	Y	4.2	-.191251	46.96117
2	7	1	R	2040	F	Y	2.3	-.527109	39.42676
2	3	1	L	2157	T	Y	4.5	.2975913	27.24366
2	3	1	L	2160	F	Y	4.5	.3628454	24.83525
2	3	1	L	2665	H	Y	4.5	.4339	24.50166
2	2	1	L	3065	F	Y	4.5	.519536	22.37002
2	2	1	L	3282	F	Y	4.5	.4993153	23.12311
2	8	1	L	3339	T	Y	2.6	.7039394	26.53997
2	7	1	R	3559	T	Y	2.3	-.501651	50.74398
2	7	1	R	5463	H	Y	2.3	-.605091	44.07656
2	8	1	L	5465	T	Y	2.6	.5070491	25.35619
2	8	1	L	5467	F	Y	2.6	.5075325	25.64576
2	4	1	R	5507	F	Y	3.9	-.070088	41.11273
2	10	1	R	6339	H	Y	3.4	-.193185	32.0029
2	10	1	R	6343	H	Y	3.4	-.214533	38.04701
2	4	1	R	6418	H	Y	3.9	.1694192	30.59337
2	3	1	R	8709	T	Y	4.2	.4321277	24.67325
2	3	1	R	9519	F	Y	4.2	.3853218	24.40014
2	3	1	R	12040	F	Y	4.2	-.088617	42.17931
2	4	1	R	13020	F	Y	3.9	.2987997	25.96758
2	3	1	L	13025	F	Y	4.5	.4603239	22.09801
2	1	1	L	14594	G	Y	4.5	.6058165	19.1578
2	1	1	L	15964	F	Y	4.5	.6026746	17.27561
2	10	1	R	16322	F	Y	3.4	-.129783	27.95116
2	7	1	R	16332	T	Y	2.3	-.872596	45.81447
2	4	1	R	16344	T	Y	3.7	.1676468	21.06496
2	7	1	R	18850	F	Y	2.3	-.423185	43.68375
2	4	1	R	18853	T	Y	3.9	.0402804	27.66395
2	7	1	R	19759	F	Y	2.3	-.526625	38.31633
2	1	1	L	19765	F	Y	2.6	.4941594	16.36773
2	7	1	R	19768	T	Y	2.3	-.454199	32.81817
2	7	1	R	19771	T	Y	2.3	-.466608	36.53761
2	4	1	R	20280	H	Y	3.9	.0399581	27.10424
2	4	1	R	20572	T	Y	3.9	.1600741	33.86173
2	4	1	R	20669	F	Y	3.9	.0440667	30.26556
2	1	1	L	22202	F	Y	2.6	.544671	16.02752
2	3	1	R	23190	F	Y	4.2	.3008943	27.6557
2	7	1	R	23339	F	Y	2.3	-.416821	42.06305
2	4	1	R	25065	F	Y	3.9	.2713285	25.27716
2	4	2	L	322	T	Y	3.2	.4654631	18.57379
2	3	2	L	343	F	Y	4.2	.4933803	21.47522
2	3	2	R	445	F	Y	4.3	.2976831	25.63633
2	4	2	L	519	F	Y	3.2	.4764171	21.40546
2	4	2	L	871	T	Y	3.5	.8063715	17.4501
2	7	2	L	2040	F	Y	2.	-.228175	33.57389
2	3	2	L	2663	F	Y	4.2	.4230451	24.8494
2	5	2	R	3280	T	Y	3.6	.5192387	24.83765
2	3	2	R	3430	F	Y	4.3	.2925068	26.3009
2	10	2	L	3554	F	Y	2.	-.003517	24.50871
2	7	2	L	3559	T	Y	2.	-.444383	36.10424
2	4	2	L	5418	F	Y	3.2	.6874224	15.98291
2	7	2	L	5463	H	Y	2.	-.304923	38.25219
2	4	2	L	5507	F	Y	3.2	.4613157	21.0458
2	10	2	L	6339	H	Y	2.	.241415	28.22567
2	10	2	L	6343	H	Y	2.	.1743897	23.76225
2	5	2	R	7190	F	Y	3.6	.2854779	27.58126
2	3	2	R	8710	T	Y	4.3	.3036823	27.17441
2	3	2	L	8715	T	Y	4.2	.6179148	20.7227
2	4	2	L	9218	F	Y	3.5	.6694249	16.11866
2	6	2	R	9522	F	Y	3.1	.3485726	22.14559

2	3	2	L	12040	F	Y	4.2	.4666943	22.49719
2	6	2	R	15970	F	Y	3.6	.6055028	19.13873
2	7	2	L	18850	F	Y	2.	-.29065	29.39626
2	4	2	L	18853	T	Y	3.2	.5457179	16.38678
2	5	2	R	19630	F	Y	3.6	.4071163	24.97414
2	7	2	L	19759	F	Y	2.	-.223831	34.23078
2	6	2	R	19762	F	Y	3.1	.4004965	19.69936
2	7	2	L	19768	T	Y	2.	.0370294	36.573
2	7	2	L	19771	T	Y	2.	-.091436	33.37644
2	4	2	L	20020	T	Y	3.2	.8456765	10.591
2	4	2	L	20281	H	Y	3.2	.3421223	20.16609
2	6	2	R	22205	F	Y	3.1	.3990484	20.19706
2	4	2	L	25060	F	Y	3.5	.6613571	16.89158
3	3	1	R	80	T	Y	3.4	.4631523	35.27486
3	3	1	R	100	T	Y	3.4	.3741867	35.14661
3	3	1	R	130	F	Y	3.4	.3863636	22.13409
3	3	1	L	333	H	Y	3.1	.4513594	20.53609
3	3	1	L	373	T	Y	4.	.6918012	16.42844
3	3	1	R	482	T	Y	3.4	.3259346	27.44825
3	3	1	L	523	F	Y	3.7	.7752762	13.67022
3	3	1	L	2100	F	Y	4.4	1.012851	13.74778
3	3	1	R	2100	F	Y	3.8	.5458794	18.9867
3	3	1	L	2971	T	Y	4.	.6684368	16.95975
3	8	1	L	3061	H	Y	3.1	1.10068	4.030544
3	3	1	R	3562	H	Y	3.4	.5538446	23.40558
3	3	1	R	3565	T	Y	3.4	.6498514	20.28238
3	3	1	R	3568	T	Y	3.4	.8330502	13.81644
3	11	1	R	3596	G	Y	4.9	.5184779	23.34289
3	11	1	R	3597	G	Y	4.	.7324529	12.23202
3	3	1	R	4056	T	Y	3.4	.4030009	33.2668
3	3	1	R	4112	T	Y	3.4	.2097995	36.93231
3	12	1	L	5340	H	Y	3.	1.010792	7.01733
3	12	1	R	5340	H	Y	3.	1.010792	7.01733
3	3	1	L	5470	F	Y	3.1	.7133603	13.65819
3	3	1	L	5490	F	Y	4.7	.6262744	18.23852
3	3	1	R	6518	F	Y	3.8	.6598344	16.61537
3	3	1	L	6518	F	Y	4.4	.7435217	15.43232
3	3	1	R	6618	F	Y	3.4	.5018055	17.78895
3	3	1	R	6848	F	Y	3.4	.4488106	18.83405
3	3	1	R	6850	H	Y	4.4	.2135726	24.28336
3	3	1	L	6850	H	Y	4.7	.4801402	23.72161
3	3	1	L	6851	H	Y	4.7	.5712617	22.76951
3	3	1	R	6851	H	Y	4.4	.3330502	21.66644
3	3	1	R	6853	F	Y	3.4	.4776976	19.05716
3	3	1	L	7023	F	Y	3.1	.767842	13.43927
3	3	1	R	7440	F	Y	3.8	.5254886	18.67039
3	3	1	L	7440	F	Y	4.4	.6263807	21.6761
3	3	1	R	7690	F	Y	3.8	.6315846	16.51777
3	3	1	L	7690	F	Y	4.4	.8648046	17.85434
3	3	1	L	8323	F	Y	4.	.5295242	16.99862
3	3	1	L	9286	F	Y	4.4	.8481309	12.5535
3	3	1	R	9286	F	Y	3.8	.6006797	18.38055
3	3	1	R	9326	F	Y	3.8	.6086449	17.19942
3	3	1	L	9326	F	Y	4.4	.6713042	17.87454
3	3	1	R	9863	F	Y	3.8	.5632965	18.05064
3	3	1	L	9863	F	Y	4.4	.8421836	15.54875
3	3	1	L	10811	F	Y	3.1	.4539083	18.63813
3	3	1	R	12033	F	Y	3.4	.5769967	18.1991
3	3	1	L	12033	F	Y	3.1	.404949	20.31146
3	3	1	L	12036	H	Y	3.7	.9067545	11.8004
3	3	1	L	12041	F	Y	3.1	.624469	14.29957
3	3	1	R	12042	F	Y	3.4	.6794818	14.56859
3	3	1	L	12071	F	Y	3.1	.6647197	15.14428
3	3	1	R	12610	F	Y	3.4	.6073705	16.1484
3	3	1	R	14193	T	Y	3.4	.5153994	23.39982
3	3	1	R	15044	F	Y	4.4	.3636364	21.09091

3	3	1	L	15494	F	Y	3.1	.8655481	9.617439
3	3	1	L	15968	F	Y	3.1	.6017418	14.65639
3	3	1	R	16623	F	Y	3.8	.5919711	18.59858
3	3	1	L	16903	F	Y	3.7	.6331776	16.18154
3	3	1	R	17183	F	Y	4.4	.3124469	19.77496
3	3	1	L	17183	F	Y	4.7	.718458	16.36227
3	3	1	R	17184	F	Y	4.4	.298322	20.57616
3	3	1	L	17184	F	Y	4.7	.7019967	17.4366
3	4	1	R	17463	T	Y	3.9	.5128505	18.49778
3	4	1	R	17743	T	Y	3.9	.6891461	16.68882
3	3	1	R	18123	T	Y	3.4	.4302252	22.05668
3	3	1	L	19774	F	Y	4.4	.835599	12.91848
3	3	1	R	19774	F	Y	3.8	.6172473	17.8438
3	3	1	L	19777	F	Y	4.4	.6948811	17.81841
3	3	1	R	19777	F	Y	3.8	.6177783	16.73172
3	8	1	L	20134	T	Y	3.1	.4688828	18.63761
3	8	1	L	20280	H	Y	3.1	.4626169	17.22009
3	4	1	R	20281	H	Y	3.9	.4648471	17.50938
3	3	1	R	20819	T	Y	3.4	.3530162	26.53241
3	3	1	L	22747	F	Y	3.7	.7749576	13.05747
3	3	1	R	23264	H	Y	3.4	.4850255	20.55052
3	3	2	R	80	T	Y	3.7	.4576655	22.94697
3	3	2	R	130	F	Y	4.5	.5005506	22.57807
3	3	2	L	130	F	Y	4.	.3466292	22.25201
3	3	2	R	332	H	Y	3.7	.4186346	22.31238
3	3	2	R	373	T	Y	3.7	.4834211	21.6491
3	3	2	L	482	T	Y	4.3	.1939924	28.25812
3	3	2	R	482	T	Y	4.5	.2415882	27.2072
3	3	2	L	523	F	Y	2.9	.2865533	33.33325
3	3	2	L	2100	F	Y	3.6	.2388964	27.92551
3	3	2	R	2971	T	Y	3.7	.3030099	23.71681
3	8	2	L	2998	H	Y	2.9	.3403279	36.4085
3	8	2	L	3061	H	Y	2.9	.2374281	42.21731
3	3	2	R	3562	H	Y	4.5	.4649456	23.52928
3	3	2	L	3562	H	Y	4.3	.3444268	26.13972
3	3	2	R	3565	T	Y	4.5	.5647254	23.32805
3	3	2	L	3565	T	Y	4.3	.3446715	26.17442
3	3	2	L	3568	T	Y	4.3	.3134712	26.75021
3	3	2	R	3568	T	Y	4.5	.6599169	22.0262
3	11	2	R	3600	G	Y	4.9	.5184779	23.34289
3	11	2	R	3601	G	Y	4.	.7324529	12.23202
3	3	2	R	4056	T	Y	3.7	.1967454	27.7985
3	12	2	R	5341	H	Y	3.	1.010792	7.01733
3	12	2	L	5341	H	Y	3.	1.010792	7.01733
3	3	2	R	5471	F	Y	3.7	.4229781	20.87829
3	3	2	L	5490	F	Y	3.3	.1793099	28.07615
3	8	2	L	5926	F	Y	2.9	.2344305	38.34223
3	8	2	L	6132	F	Y	2.9	.4238346	33.99974
3	3	2	L	6518	F	Y	3.6	.2338187	31.05549
3	3	2	R	6618	F	Y	4.5	.4823811	25.15163
3	3	2	L	6618	F	Y	4.	.3030711	23.57548
3	3	2	L	6848	F	Y	4.	.322036	22.7647
3	3	2	R	6848	F	Y	4.5	.4247523	25.87987
3	3	2	L	6850	H	Y	3.3	.1345283	28.22612
3	3	2	L	6851	H	Y	3.3	.2043313	25.67418
3	3	2	R	6853	F	Y	4.5	.6491497	20.29942
3	3	2	L	6853	F	Y	4.	.4279947	20.58964
3	3	2	L	7023	F	Y	3.9	.4092133	23.37644
3	3	2	R	7023	F	Y	4.6	.6486603	23.23002
3	3	2	L	7440	F	Y	3.6	.430197	23.40193
3	3	2	L	7690	F	Y	3.6	.3037441	25.52091
3	3	2	L	8323	F	Y	2.9	.3383703	27.4309
3	3	2	L	9286	F	Y	3.6	.2216445	32.87918
3	3	2	L	9326	F	Y	3.6	.1359354	32.17564
3	3	2	L	9863	F	Y	3.6	.2565154	27.92388
3	3	2	L	10811	F	Y	2.9	.2239692	37.00883

3	3	2	L	12034	P	Y	4.	.4265264	22.28144
3	3	2	R	12034	F	Y	4.5	.5398875	21.50604
3	3	2	L	12036	H	Y	2.9	.3088218	36.59092
3	3	2	L	12041	F	Y	4.	.4237734	20.44107
3	3	2	R	12042	F	Y	4.5	.5590359	21.37128
3	3	2	L	12071	F	Y	2.9	.1900159	40.14426
3	3	2	R	12610	F	Y	4.5	.6477426	22.1499
3	3	2	L	12610	F	Y	4.	.512786	19.71306
3	3	2	L	14193	T	Y	4.3	.5087483	22.74051
3	3	2	R	14193	T	Y	4.5	.4256088	25.60132
3	3	2	L	15044	F	Y	3.3	.2193809	25.40821
3	3	2	R	15495	F	Y	3.7	.3962437	21.73736
3	3	2	R	15971	F	Y	3.7	.2993393	23.59631
3	3	2	L	16623	F	Y	3.9	.5145602	20.71463
3	3	2	R	16623	F	Y	4.6	.6517191	21.86377
3	3	2	L	16903	F	Y	2.9	.2675272	35.18536
3	3	2	L	17183	F	Y	3.3	.2498471	23.52831
3	3	2	L	17184	F	Y	3.3	.1982748	24.06537
3	4	2	L	17463	T	Y	3.7	.564603	19.0107
3	4	2	L	17743	T	Y	3.7	.5411722	21.93821
3	3	2	R	18123	T	Y	4.5	.3165913	28.44264
3	3	2	L	18123	T	Y	4.	.3184877	24.86156
3	3	2	L	19774	F	Y	3.6	.2354093	31.98104
3	3	2	L	19777	F	Y	3.6	.1703781	30.80961
3	4	2	L	20281	H	Y	3.7	.3942249	19.80109
3	3	2	L	20819	T	Y	4.3	.4969412	22.01626
3	3	2	R	20819	T	Y	4.5	.4748563	23.93461
3	3	2	L	22747	F	Y	2.9	.2891228	35.5976
3	3	2	R	23264	H	Y	4.5	.5498593	21.97005
3	3	2	L	23264	H	Y	4.	.3233207	23.39687
4	6	3	R	327	T	Y	4.7	.036719	33.80857
4	3	3	L	341	T	Y	5.5	.2764194	29.14886
4	3	3	R	444	T	Y	5.9	-.071656	37.30136
4	3	3	L	444	T	Y	5.6	.311716	30.48468
4	3	3	L	700	T	Y	5.5	.3305237	27.90451
4	5	3	R	2100	F	Y	5.1	.0059003	35.57053
4	5	3	R	2280	F	Y	5.1	-.016068	34.33829
4	5	3	R	2281	F	Y	5.1	-.066063	35.62103
4	5	3	L	2864	F	Y	5.7	.0319777	37.74118
4	5	3	R	2864	F	Y	5.1	-.002423	34.63889
4	5	3	L	2917	F	Y	5.7	.5086925	25.52355
4	5	3	R	2917	F	Y	5.1	-.067064	35.80014
4	5	3	R	2944	T	Y	5.1	-.030555	36.69904
4	5	3	L	2944	T	Y	5.7	.1628912	37.56856
4	5	3	L	3025	T	Y	5.7	.1731641	37.51457
4	5	3	R	3025	T	Y	5.1	.031925	35.71376
4	5	3	R	3061	H	Y	5.1	.0613739	33.93899
4	9	3	R	3062	G	Y	4.9	.0039651	35.97573
4	4	3	R	3301	T	Y	4.6	.2848488	36.83532
4	4	3	L	3301	T	Y	5.7	.6039933	29.21809
4	4	3	R	3320	T	Y	4.6	-.283175	48.39061
4	4	3	L	3320	T	Y	5.7	.5736487	30.5268
4	3	3	L	3490	T	Y	5.5	.2806719	28.32345
4	2	3	L	3571	F	Y	4.5	.5108524	23.24758
4	2	3	L	3588	F	Y	4.5	.3640291	28.34073
4	11	3	R	3595	G	Y	5.8	.2706775	31.66056
4	11	3	R	3598	G	Y	5.8	.0217048	28.49516
4	6	3	R	3700	F	Y	5.1	-.012644	34.72029
4	3	3	L	4541	F	Y	5.5	.5432515	21.30808
4	5	3	R	5475	F	Y	5.1	.0471499	33.83682
4	5	3	L	5475	F	Y	5.7	.1817511	34.58329
4	2	3	L	5611	F	Y	4.5	.3377937	28.88784
4	5	3	R	6718	H	Y	5.1	.0127489	34.63454
4	2	3	L	6849	F	Y	4.5	.4192393	27.57212
4	5	3	R	7940	F	Y	5.1	-.041671	37.31438
4	3	3	R	8708	T	Y	5.9	.1067404	33.3224

4	3	3	L	8708	T	Y	5.6	.3516904	28.15257
4	3	3	L	8714	T	Y	5.5	.2885393	28.40313
4	3	3	R	8714	T	Y	5.9	.0810121	34.86275
4	4	3	L	9366	T	Y	5.7	.5526816	27.31545
4	4	3	R	9366	T	Y	4.6	.0449373	38.68537
4	4	3	L	9406	T	Y	5.3	.5422506	28.48719
4	4	3	R	9406	T	Y	4.6	.0401433	38.09057
4	12	3	L	9480	T	Y	4.	.1349888	30.21867
4	2	3	L	9520	T	Y	4.5	.53772	24.72946
4	2	3	L	9521	T	Y	4.5	.541355	24.92113
4	2	3	L	11420	H	Y	4.5	.5394585	22.33417
4	3	3	L	12045	F	Y	5.5	.5359815	20.32475
4	3	3	L	12058	F	Y	5.5	.5103256	22.47343
4	2	3	L	12084	F	Y	4.5	.5441471	22.57415
4	6	3	R	12133	T	Y	4.7	-.15625	34.61562
4	3	3	L	13065	F	Y	5.6	.299596	29.89708
4	3	3	R	13065	F	Y	5.9	-.046566	36.35815
4	3	3	L	14393	T	Y	5.5	.5438838	23.13707
4	6	3	R	15984	F	Y	4.7	.0512591	34.77523
4	6	3	R	15998	F	Y	4.7	.0533663	33.77185
4	6	3	R	16012	F	Y	4.7	-.01238	36.75737
4	5	3	L	16623	F	Y	5.7	.1163734	34.96072
4	5	3	R	16623	F	Y	5.1	.0424086	34.06943
4	2	3	L	18216	F	Y	4.5	.4458962	24.34434
4	2	3	L	18309	F	Y	4.5	.4852492	23.82368
4	4	3	R	18851	H	Y	4.6	.1006743	36.69092
4	4	3	L	18851	H	Y	5.7	.517543	27.82934
4	12	3	R	19024	F	Y	5.2	-.15984	37.06207
4	3	3	L	19767	T	Y	5.5	.3193706	27.11896
4	3	3	L	19780	F	Y	5.5	.4769256	22.49204
4	4	3	L	19914	T	Y	5.7	.3351597	32.31707
4	4	3	R	19914	T	Y	4.6	.0398799	37.25349
4	4	3	R	19969	T	Y	4.6	.0005268	38.67416
4	4	3	L	19969	T	Y	5.7	.3548098	30.24303
4	1	3	L	20282	H	Y	4.5	.4152355	23.68855
4	4	3	L	20969	T	Y	5.7	.4416816	27.9511
4	4	3	R	20969	T	Y	4.6	.0457802	37.82402
4	4	3	R	21119	T	Y	4.6	.0063218	37.48985
4	4	3	L	21119	T	Y	5.7	.5237067	27.23695
4	3	4	L	341	T	Y	4.5	-.209721	39.70525
4	3	4	L	444	T	Y	6.	-.034654	37.80545
4	3	4	R	444	T	Y	6.	.0886589	33.8839
4	3	4	L	700	T	Y	4.5	.0607561	33.42552
4	5	4	R	3061	H	Y	4.9	.369487	27.69519
4	9	4	R	3062	G	Y	3.8	-.075697	36.08964
4	3	4	L	3490	T	Y	4.5	.1773177	30.56781
4	2	4	L	3584	F	Y	4.	.3780378	26.42544
4	11	4	R	3595	G	Y	5.1	-.134564	39.98348
4	11	4	R	3598	G	Y	5.1	.037844	28.35356
4	3	4	L	4541	F	Y	4.5	.2065707	28.38009
4	2	4	L	5611	F	Y	4.	.4554456	26.23795
4	3	4	R	8708	T	Y	6.	.1912691	31.71367
4	3	4	L	8708	T	Y	6.	.0085509	35.76359
4	3	4	R	8714	T	Y	6.	.2835284	31.28575
4	3	4	L	8714	T	Y	4.5	.0711071	33.54986
4	4	4	R	9366	T	Y	5.5	.2808281	34.61128
4	4	4	L	9366	T	Y	4.8	.3865887	31.2557
4	4	4	L	9406	T	Y	4.8	.3069307	33.64224
4	4	4	R	9406	T	Y	5.5	.1525653	36.49074
4	12	4	L	9480	T	Y	4.	.1349888	30.21867
4	2	4	L	9520	T	Y	4.	.419442	26.65617
4	2	4	L	9521	T	Y	4.	.4338434	26.74221
4	2	4	L	9523	T	Y	4.	.4041404	27.05641
4	2	4	L	9524	T	Y	4.	.4346961	26.38971
4	3	4	L	12045	F	Y	4.5	.2632764	25.87724
4	3	4	L	12058	F	Y	4.5	.2412241	27.90798

4	6	4	R	12133	T	Y	4.2	.0814582	32.80754
4	6	4	R	12166	F	Y	4.2	.3883889	23.24979
4	3	4	L	13065	F	Y	6.	-.052655	37.79788
4	3	4	R	13065	F	Y	6.	.1705671	31.23164
4	3	4	L	14393	T	Y	4.5	.1431143	31.51344
4	6	4	R	15984	F	Y	4.2	.1435644	33.58696
4	6	4	R	15998	F	Y	4.2	.2214222	30.70633
4	6	4	R	16012	F	Y	4.2	.1309631	34.22834
4	4	4	R	18851	H	Y	5.5	.1440144	36.96049
4	4	4	L	18851	H	Y	4.8	.3577858	31.11694
4	12	4	R	19024	F	Y	3.4	-.15984	37.06207
4	3	4	L	19767	T	Y	4.5	.0427543	33.28462
4	3	4	L	19780	F	Y	4.5	.2182718	27.89167
4	4	4	L	19914	T	Y	4.8	.4743475	29.12589
4	4	4	R	19914	T	Y	5.5	.3388839	31.329
4	4	4	R	19969	T	Y	5.5	.3910891	31.12426
4	4	4	L	19969	T	Y	4.8	.4734474	27.81218
4	1	4	L	20282	H	Y	4.	.519352	20.71146
4	4	4	L	20969	T	Y	4.8	.3177318	30.57345
4	4	4	R	20969	T	Y	5.5	.3141315	32.3186
4	4	4	R	21119	T	Y	5.5	.3514852	30.62096
4	4	4	L	21119	T	Y	4.8	.3528353	30.67486
5	3	1	L	310	F	Y	5.3	.6772617	15.97544
5	3	1	L	342	F	Y	5.3	.6577142	15.53012
5	3	1	R	400	F	Y	4.7	.6034845	16.60966
5	3	1	R	900	H	Y	6.6	.7478984	15.56026
5	3	1	R	2866	T	Y	6.2	.3564593	30.18958
5	3	1	R	2870	T	Y	6.2	.4373841	29.59825
5	3	1	L	3580	T	Y	5.3	.740832	16.32809
5	11	1	R	3605	G	Y	5.7	.791515	7.114012
5	11	1	R	3610	G	Y	5.7	.7616251	4.871031
5	4	1	R	3615	T	Y	5.6	1.156475	1.191723
5	3	1	R	3884	T	Y	6.	.3320112	27.76448
5	4	1	R	4000	T	Y	5.9	.5970679	19.5632
5	4	1	L	4170	T	Y	4.9	.8810224	15.42153
5	3	1	L	4489	T	Y	5.3	.5901098	19.37865
5	4	1	R	5247	T	Y	5.9	1.014986	9.726849
5	4	1	R	5252	T	Y	5.9	.9094503	12.97165
5	4	1	R	5257	T	Y	5.9	.8041587	15.84859
5	4	1	R	5262	T	Y	5.9	.627391	20.69666
5	3	1	R	5429	T	Y	5.6	.5678818	22.57975
5	3	1	R	5464	H	Y	6.6	.7832032	16.48422
5	4	1	R	5720	F	Y	5.6	.817073	10.25221
5	4	1	R	6382	H	Y	5.6	.8408713	12.8916
5	7	1	R	6852	T	Y	3.7	-.311911	34.71186
5	8	1	L	6857	T	Y	4.9	.5977177	18.94892
5	7	1	R	8450	F	Y	3.7	-.727633	42.01945
5	3	1	R	9041	F	Y	6.	.5506086	20.03444
5	3	1	R	9046	F	Y	6.6	.6059482	17.968
5	7	1	R	9246	F	Y	3.7	-.609728	35.64062
5	3	1	R	12030	F	Y	5.6	.3900855	26.12544
5	3	1	R	12045	F	Y	5.6	.2865265	27.66429
5	10	1	R	13700	F	Y	4.7	.2944322	17.74051
5	10	1	L	13700	F	Y	7.1	.1380244	20.94105
5	3	1	R	13993	F	Y	6.	.2330008	28.50335
5	3	1	L	15966	T	Y	5.3	.7466531	17.06264
5	3	1	L	16026	H	Y	4.9	.8495621	14.43806
5	4	1	R	16343	F	Y	5.6	.7618687	12.10317
5	3	1	R	18030	F	Y	4.7	.4759378	19.75079
5	3	1	L	18030	F	Y	7.1	.6086557	19.25849
5	10	1	R	18400	F	Y	6.	.0234734	24.39653
5	3	1	R	18450	F	Y	6.	.2571239	26.4856
5	10	1	R	19444	F	Y	5.6	-.092377	32.48057
5	3	1	R	20085	T	Y	5.6	.4233597	32.78152
5	4	1	R	20282	H	Y	5.6	.8855708	9.721548
5	3	1	L	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

5	3	2	L	130	F	Y	4.2	.0241773	38.75605
5	3	2	L	900	H	Y	4.2	.4793762	25.43771
5	10	2	L	2411	F	Y	5.2	.1190995	20.94454
5	3	2	L	2862	F	Y	5.2	.4799177	21.57581
5	3	2	L	2866	T	Y	5.8	.6208662	19.30259
5	3	2	L	2870	T	Y	6.7	.6246836	20.70618
5	3	2	R	3576	T	Y	7.3	.5215308	21.2986
5	11	2	L	3606	G	Y	5.8	.9150547	3.710956
5	11	2	L	3611	G	Y	5.8	.8137429	3.012914
5	4	2	L	3615	T	Y	4.3	.9141341	6.95619
5	3	2	L	3884	T	Y	5.2	.3849955	23.58732
5	4	2	L	4001	T	Y	5.7	.9262093	11.91576
5	4	2	R	4170	T	Y	5.4	.7463552	17.95668
5	3	2	R	4254	T	Y	6.3	.5487675	20.72491
5	3	2	R	4439	F	Y	6.3	.2746409	24.26305
5	3	2	L	4439	F	Y	7.5	.5769788	19.67979
5	4	2	L	5247	T	Y	5.7	.9243141	12.33242
5	4	2	L	5252	T	Y	5.7	1.018803	9.330436
5	4	2	L	5257	T	Y	5.7	.7318434	17.97567
5	4	2	L	5262	T	Y	5.7	.6531657	18.8301
5	3	2	L	5429	T	Y	6.2	.6086557	18.35849
5	3	2	L	5464	H	Y	4.2	.3904645	30.6421
5	10	2	L	5480	F	Y	4.2	-.018167	30.33683
5	4	2	L	5715	F	Y	4.3	.693046	15.39098
5	4	2	L	6382	H	Y	4.3	.9566948	8.170654
5	7	2	L	6852	T	Y	3.5	-.705882	39.15882
5	7	2	L	9246	F	Y	3.5	-.5503	37.82396
5	3	2	L	12030	F	Y	6.2	.6511351	16.06224
5	3	2	L	12045	F	Y	6.2	.680998	14.76831
5	10	2	L	12100	F	Y	5.2	-.020549	24.8892
5	3	2	L	12200	F	Y	5.2	.2073615	27.75444
5	10	2	L	13701	F	Y	7.5	.2915623	17.1286
5	10	2	R	13701	F	Y	6.3	.115255	21.70405
5	7	2	L	13750	F	Y	4.3	-.743739	42.46678
5	3	2	L	13973	F	Y	5.2	.5320897	19.4915
5	3	2	R	15969	T	Y	7.3	.5931963	20.08581
5	3	2	R	19766	F	Y	6.3	.2714191	25.17137
5	3	2	L	19766	F	Y	7.5	.5060173	20.75211
5	3	2	L	20085	T	Y	6.2	.6921255	19.23622
5	4	2	L	20282	F	Y	4.3	.8734416	10.08816
5	3	2	R	21745	T	Y	7.3	.5684234	20.91785

RELATION: RCHNOTE

ANUM	REGNUM	CREWSTAN	CONTHAND	CONTNUM	RNOTENUM

RELATION: VIEW

VIEWNUM	VIEW
1	OVER THE NOSE VISION
2	VISION OVER THE SIDE OF GLARE SHIELD
3	VISION OUT OF THE SIDE WINDOW
4	VISION OVERHEAD
5	VISION OVER THE CANOPY BOW
6	VISION UNDER THE CANOPY BOW
7	UNDER VISION OVERHEAD

RELATION: CREWVIEW

ANUM	CREWSTAN	VIEWNUM
1	3	1
1	3	2
2	1	1
2	1	2
2	1	3
2	1	4
2	2	1
2	2	2
2	2	3
2	2	4
3	1	1
3	1	5
3	1	6
3	2	1
3	2	5
3	2	6
4	3	1
4	3	2
4	3	5
4	3	6
4	4	2
4	4	5
4	4	6
5	1	1
5	1	2
5	1	3
5	1	4
5	2	1
5	2	2
5	2	3
5	2	4

RELATION: VISNOTE

ANUM	VIEWNUM	HEADPOSN	CREWSTAN	VNOTENUM
2	1	1	1	1
2	1	1	2	1
2	2	1	1	2
2	2	1	2	2
2	3	1	1	3
2	3	1	2	3
2	4	1	1	4
2	4	1	2	4
3	1	1	1	5
3	1	1	2	5
3	1	2	1	5
3	1	2	2	5
3	5	1	1	6
3	5	1	2	6
3	5	2	1	6
3	5	2	2	6
3	6	1	1	6
3	6	1	2	6
3	6	2	1	6
3	6	2	2	6
4	1	1	3	7
4	1	2	3	7
5	1	1	1	8
5	1	1	2	8
5	1	2	1	8

5	1	2	2	8
5	2	1	1	8
5	2	1	2	8
5	2	2	1	8
5	2	2	2	8
5	3	1	1	8
5	3	1	2	8
5	3	2	1	8
5	3	2	2	8
5	7	1	1	8
5	7	1	2	8
5	7	2	1	8
5	7	2	2	8

RELATION: CLRTITLE

TITLENUM	TITLE	M
1	OVERHEAD CLEARANCE	N
2	MINIMUM LEG LENGTH FOR FULL RUDDER THROW	Y
3	SHIN CLEARANCE WITH INSTRUMENT PANEL	N
4	EJECTION CLEARANCE WITH GLARE SHIELD	N
5	EJECTION CLEARANCE WITH CANOPY BOW	N

RELATION: CREWTITL

ANUM	CREWSTAN	TITLENUM	FMTTYPE
1	3	1	1
1	3	2	1
1	3	3	1
1	3	4	1
2	1	1	1
2	1	2	1
2	1	3	1
2	2	1	1
2	2	2	1
2	2	3	1
3	1	1	1
3	1	2	1
3	1	3	1
3	1	5	1
3	2	1	1
3	2	2	1
3	2	3	1
3	2	5	1
4	3	1	1
4	3	2	1
4	3	3	2
4	3	5	1
4	4	1	1
4	4	2	1
4	4	3	2
4	4	5	1
5	1	1	1
5	1	2	1
5	1	3	1
5	2	1	1
5	2	2	1
5	2	3	1

RELATION: TYPETWO

ANUM	TITLENUM	CREWSTAN	LINEMNUM	LINEMVAL	MNUM	LOWVAL	LOWCLR	UPVAL	UPCLR	DEGSUBT
4	3	3	529	22.	194	31.	0.	24.	5.	.2
4	3	4	529	22.	194	31.	0.	24.	5.	.2

RELATION: CLRNOTE

ANUM	TITLENUM	CREWSTAN	CNOTENUM
1	1	3	1
1	4	3	2
2	1	1	3
2	1	2	3
4	1	3	1
4	1	4	1
5	1	1	3
5	1	2	3
5	2	1	4
5	2	2	4
5	3	1	5
5	3	2	5

RELATION: MNAME

MNUM	MNAME
194	BUTTOCK-KNEE-LENGTH
545	LEG-LENGTH
758	SITTING-HEIGHT

RELATION: LINEMNAM

LINEMNUM	LINEMNAM
529	KNEE-HEIGHT-SITTING

RELATION: REGION

REGNUM	REGION
1	LEFT-SIDE-PANEL
2	LEFT-AUXILIARY-PANEL
3	MAIN-INSTRUMENT-PANEL
4	CENTER-PEDESTAL
5	RIGHT-AUXILIARY-PANEL
6	RIGHT-SIDE-PANEL
7	OVERHEAD-CONTROL-PANEL
8	LEFT-BULKHEAD
9	RIGHT-BULKHEAD
10	GLARE-SHIELD
11	CONTROL-STICK
12	SEAT

RELATION: VNOTE

VNOTENUM	VNOTE
1	Moving seat full aft loses 2 degrees in each position.
2	Moving seat aft loses 3.5 degrees in each position.
3	Moving seat aft loses 2.6 degrees in each position.
4	Moving seat aft loses 11 degrees in each position.
5	~~As the seat goes down they see less.~~
6	As the seat goes down they see more.
7	Add 1 degree per inch from 30 inches to 36 inches: Add 2 degrees per
8	Data available for forward positions only.

RELATION: CNOTE

CNOTENUM	CNOTE
1	These values allow 1.5 inches for the HGU-55/P and 1 inch space over
2	Thigh held perpendicular to ejection rail.
3	Clearance space overhead for mobility is 1 inch.
4	Data is available for full forward positions only.
5	Data is available for full aft positions only.

RELATION: RNOTE

RNOTENUM	RNOTE

RELATION: VISION

ANUM	VIEWNUM	HEADPOSN	CREWSTAN	MINEHT	MINVDEG	MAXEHT	MAXVDEG	ABVGLARE GLAREDN	GLAREHT	BLWGLARE
1	1	1	3	26.	-2.23	36.	-31.14	-2.89	26.	-2.89
1	1	2	3	26.	-7.	36.	-32.	-2.5	26.	-2.5
1	2	1	3	26.	-19.	36.	-32.	-2.5	26.	-2.5
1	2	2	3	26.	-21.	36.	-34.	-2.5	26.	-2.5
2	1	1	1	26.	-6.	36.	-22.	-3.	29.	-1.
2	1	1	2	26.	-6.	36.	-22.	-3.	29.	-1.
2	1	2	1	26.	-14.	36.	-24.	-3.	29.	-1.
2	1	2	2	26.	-14.	36.	-24.	-3.	29.	-1.
2	2	1	1	26.	-15.5	36.	-30.5	-1.5	25.	-1.5
2	2	1	2	26.	-15.5	36.	-30.5	-1.5	25.	-1.5
2	2	2	1	26.	-17.5	36.	-32.5	-1.5	25.	-1.5
2	2	2	2	26.	-17.5	36.	-32.5	-1.5	25.	-1.5
2	3	1	1	26.	-22.5	36.	-37.5	-1.5	25.	-1.5
2	3	1	2	26.	-22.5	36.	-37.5	-1.5	25.	-1.5
2	3	2	1	26.	-24.5	36.	-39.5	-1.5	25.	-1.5
2	3	2	2	26.	-24.5	36.	-39.5	-1.5	25.	-1.5
2	4	1	1	26.	27.	36.	20.	.7	25.	.7
2	4	1	2	26.	27.	36.	20.	.7	25.	.7
3	1	1	1	26.	-7.	36.	-18.	-.6875	25.	-.6875
3	1	1	2	26.	-7.	36.	-18.	-.6875	25.	-.6875
3	1	2	1	26.	-9.	36.	-20.	-.6875	25.	-.6875
3	1	2	2	26.	-9.	36.	-20.	-.6875	25.	-.6875
3	5	1	1	26.	33.25	36.	-1.75	-2.1875	25.	-2.1875
3	5	1	2	26.	33.25	36.	-1.75	-2.1875	25.	-2.1875
3	5	2	1	26.	31.25	36.	-3.75	-2.1875	25.	-2.1875
3	5	2	2	26.	31.25	36.	-3.75	-2.1875	25.	-2.1875
3	6	1	1	26.	21.25	36.	-13.75	-2.1875	25.	-2.1875
3	6	1	2	26.	21.25	36.	-13.75	-2.1875	25.	-2.1875

-2.89 /EYE-HT-SIT

2.4 /1" OFF SEATADJ

3	6	2	1	26.	19.25	36.	-15.75	-2.1875	25.	-2.1875
3	6	2	2	26.	19.25	36.	-15.75	-2.1875	25.	-2.1875
4	1	1	3	24.	1.	36.	-15.5	-3.	30.	-.75
4	1	2	3	26.	-1.	36.	-16.5	-3.	30.	-.75
4	2	1	3	26.	-18.	36.	-32.	0.	25.	-1.4
4	2	1	4	26.	-8.6	36.	-21.1	-1.2	25.	-1.25
4	2	2	3	26.	-20.	36.	-34.	0.	25.	-1.1
4	2	2	4	26.	-9.6	36.	-22.1	-1.2	25.	-1.25
4	5	1	3	26.	17.5	36.	7.5	0.	25.	-1.
4	5	1	4	26.	17.	36.	1.	-1.6	25.	-1.6
4	5	2	3	26.	15.5	36.	5.5	0.	25.	-1.
4	5	2	4	26.	15.	36.	-1.	-1.6	25.	-1.6
4	6	1	3	26.	10.	36.	0.	0.	25.	-1.
4	6	1	4	26.	12.	36.	-4.	-1.6	25.	-1.6
4	6	2	3	26.	8.	36.	-2.	0.	25.	-1.
4	6	2	4	26.	10.	36.	-6.	-1.6	25.	-1.6
5	1	1	1	26.	-6.	36.	-26.	-2.	25.	-2.
5	1	1	2	26.	-6.	36.	-26.	-2.	25.	-2.
5	1	2	1	26.	-8.	36.	-28.	-2.	25.	-2.
5	1	2	2	26.	-8.	36.	-28.	-2.	25.	-2.
5	2	1	1	26.	-33.	36.	-53.	-2.	25.	-2.
5	2	1	2	26.	-33.	36.	-53.	-2.	25.	-2.
5	2	2	1	26.	-35.	36.	-55.	-2.	25.	-2.
5	2	2	2	26.	-35.	36.	-55.	-2.	25.	-2.
5	3	1	1	26.	-33.	36.	-53.	-2.	25.	-2.
5	3	1	2	26.	-33.	36.	-53.	-2.	25.	-2.
5	3	2	1	26.	-35.	36.	-55.	-2.	25.	-2.
5	3	2	2	26.	-35.	36.	-55.	-2.	25.	-2.
5	4	1	1	26.	22.	36.	4.	-1.8	25.	-1.8
5	4	1	2	26.	22.	36.	4.	-1.8	25.	-1.8
5	4	2	1	26.	20.	36.	2.	-1.8	25.	-1.8
5	4	2	2	26.	20.	36.	2.	-1.8	25.	-1.8

RELATION: CREWREG

ANUM	CREWSTAN	REGNUM
1	3	1
1	3	2
1	3	3
1	3	4
1	3	5
1	3	6
2	1	1
2	1	2
2	1	3
2	1	4
2	1	7
2	1	8
2	1	10
2	2	3
2	2	4
2	2	5
2	2	6
2	2	7
2	2	10
3	1	3
3	1	4
3	1	8
3	1	11
3	1	12
3	2	3
3	2	4
3	2	8

3	2	11
3	2	12
4	3	1
4	3	2
4	3	3
4	3	4
4	3	5
4	3	6
4	3	9
4	3	11
4	3	12
4	4	1
4	4	2
4	4	3
4	4	4
4	4	5
4	4	6
4	4	9
4	4	11
4	4	12
5	1	3
5	1	4
5	1	7
5	1	8
5	1	10
5	1	11
5	2	3
5	2	4
5	2	7
5	2	10
5	2	11

RELATION: VISADJ

ANUM	VIEWNUM	HEADPOSN	CREWSTAN	ADJDEG
2	1	1	1	-2.
2	1	1	2	-2.
2	1	2	1	-2.
2	1	2	2	-2.
2	2	1	1	-3.5
2	2	1	2	-3.5
2	2	2	1	-3.5
2	2	2	2	-3.5
2	3	1	1	-2.6
2	3	1	2	-2.6
2	3	2	1	-2.6
2	3	2	2	-2.6
2	4	1	1	-11.
2	4	1	2	-11.
2	4	2	1	-11.
2	4	2	2	-11.

RELATION: TYPEONE

ANUM	TITLENUM	CREWSTAN	SEATPOS	MNUM	MVAL	CLRCHNG	
1	1	3	1	758	40.5	1.	ADD 1" FOR CLEARANCE VALUE TO CONTACT
1	1	3	2	758	36.2	1.	
1	2	3	1	545	35.	1.	
1	2	3	2	545	32.6	1.	
1	3	3	9	194	26.5	1.	

1	4	3	9	194	29.5	1.
2	1	1	5	758	44.1	1.
2	1	1	6	758	50.1	1.
2	1	1	7	758	39.1	1.
2	1	1	8	758	45.1	1.
2	1	2	5	758	44.1	1.
2	1	2	6	758	50.1	1.
2	1	2	7	758	39.1	1.
2	1	2	8	758	45.1	1.
2	2	1	5	545	39.6	1.
2	2	1	7	545	40.6	1.
2	2	2	5	545	39.6	1.
2	2	2	7	545	40.6	1.
2	3	1	6	194	30.	1.
2	3	1	8	194	30.	1.
2	3	2	6	194	30.	1.
2	3	2	8	194	30.	1.
3	1	1	1	758	40	1.
3	1	1	2	758	35	1.
3	1	2	1	758	40	1.
3	1	2	2	758	35	1.
3	2	1	1	545	41	.3
3	2	1	2	545	42.5	.3
3	2	2	1	545	41.	.3
3	2	2	2	545	42.5	.3
3	3	1	9	194	29.	.7
3	3	2	9	194	29.	.7
3	5	1	9	194	26.4	1.
3	5	2	9	194	26.4	1.
4	1	3	1	758	45.	.9
4	1	3	2	758	40.5	.9
4	1	4	1	758	39.5	.9
4	1	4	2	758	35	.9
4	2	3	1	545	40.3	1.
4	2	3	2	545	43.	1.
4	2	4	1	545	40.75	1.
4	2	4	2	545	42.75	1.
4	5	3	9	194	30.8	1.
4	5	4	9	194	32.8	1.
5	1	1	5	758	42.6	1.
5	1	1	6	758	43.3	1.
5	1	1	7	758	38.1	1.
5	1	1	8	758	38.8	1.
5	1	2	5	758	42.6	1.
5	1	2	6	758	43.3	1.
5	1	2	7	758	38.1	1.
5	1	2	8	758	38.8	1.
5	2	1	5	545	38.2	1.
5	2	1	7	545	39.6	1.
5	2	2	5	545	38.2	1.
5	2	2	7	545	39.6	1.
5	3	1	4	194	27.9	1.
5	3	2	4	194	27.9	1.

```
FILE "aircraft.load" DELIMITER ":" 3 ;
INSERT INTO aircraft;

FILE "catname.load" DELIMITER ":" 2 ;
INSERT INTO catname;

FILE "crewsta.load" DELIMITER ":" 2 ;
INSERT INTO crewsta;

FILE "aircrew.load" DELIMITER ":" 2 ;
INSERT INTO aircrew;

FILE "airreg.load" DELIMITER ":" 2 ;
INSERT INTO airreg;

FILE "control.load" DELIMITER ":" 2 ;
INSERT INTO control;

FILE "crewcont.load" DELIMITER ":" 3 ;
INSERT INTO crewcont;

FILE "seatadj.load" DELIMITER ":" 4 ;
INSERT INTO seatadj;

FILE "reach.load" DELIMITER ":" 10 ;
INSERT INTO reach;

FILE "view.load" DELIMITER ":" 2 ;
INSERT INTO view;

FILE "crewview.load" DELIMITER ":" 3 ;
INSERT INTO crewview;

FILE "visnote.load" DELIMITER ":" 5 ;
INSERT INTO visnote;

FILE "clrtitle.load" DELIMITER ":" 3 ;
INSERT INTO clrtitle;

FILE "crewtitl.load" DELIMITER ":" 4 ;
INSERT INTO crewtitl;

FILE "typetwo.load" DELIMITER ":" 11 ;
INSERT INTO typetwo;

FILE "clrnote.load" DELIMITER ":" 4 ;
INSERT INTO clrnote;

FILE "mname.load" DELIMITER ":" 2 ;
INSERT INTO mname;

FILE "linemnam.load" DELIMITER ":" 2 ;
INSERT INTO linemnam;

FILE "region.load" DELIMITER ":" 2 ;
INSERT INTO region;

FILE "vnote.load" DELIMITER ":" 2 ;
INSERT INTO vnote;

FILE "cnote.load" DELIMITER ":" 2 ;
INSERT INTO cnote;

FILE "vision.load" DELIMITER ":" 11 ;
INSERT INTO vision;
```

```
FILE "crewreg.load" DELIMITER ":" 3 ;
INSERT INTO crewreg;

FILE "visadj.load" DELIMITER ":" 5 ;
INSERT INTO visadj;

FILE "typeone.load" DELIMITER ":" 7 ;
INSERT INTO typeone;
```

```
create table "card".crewcont
  (
    anum smallint not null,
    crewstan smallint not null,
    contnum smallint not null
  );
revoke all on "card".crewcont from "public";

{ TABLE "card".seatadj row size = 23 number of columns = 4 index size = 0 }
{ unload file name = seatadj108.unl number of rows = 7 }

create table "card".seatadj
  (
    anum smallint not null,
    adjdir char(1),
    adjinc decimal(16),
    maxadj decimal(16)
  );
revoke all on "card".seatadj from "public";

{ TABLE "card".reach row size = 41 number of columns = 10 index size = 0 }
{ unload file name = reach__110.unl number of rows = 474 }

create table "card".reach
  (
    anum smallint not null,
    regnum smallint not null,
    crewstan smallint not null,
    conthand char(1) not null,
    contnum smallint not null,
    conttype char(1),
    measured char(1),
    z2factor decimal(16),
    shscoef decimal(16),
    constant decimal(16)
  );
revoke all on "card".reach from "public";

{ TABLE "card".rchnote row size = 11 number of columns = 6 index size = 0 }
{ unload file name = rchnote111.unl number of rows = 0 }

create table "card".rchnote
  (
    anum smallint not null,
    regnum smallint not null,
    crewstan smallint not null,
    conthand char(1) not null,
    contnum smallint not null,
    rnotenum smallint not null
  );
revoke all on "card".rchnote from "public";

{ TABLE "card".view row size = 62 number of columns = 2 index size = 0 }
{ unload file name = view___112.unl number of rows = 6 }

create table "card".view
  (
    viewnum smallint not null,
    view char(60) not null
  );
revoke all on "card".view from "public";

{ TABLE "card".crewview row size = 6 number of columns = 3 index size = 0 }
{ unload file name = crewvie113.unl number of rows = 31 }
```

```
create table "card".crewview
  (
    anum smallint not null,
    crewstan smallint not null,
    viewnum smallint
  );
revoke all on "card".crewview from "public";

{ TABLE "card".visnote row size = 10 number of columns = 5 index size = 0 }
{ unload file name = visnote114.unl number of rows = 16 }

create table "card".visnote
  (
    anum smallint not null,
    viewnum smallint not null,
    headposn smallint not null,
    crewstan smallint not null,
    vnotenum smallint
  );
revoke all on "card".visnote from "public";

{ TABLE "card".clrtitle row size = 63 number of columns = 3 index size = 0 }
{ unload file name = clrtitl115.unl number of rows = 5 }

create table "card".clrtitle
  (
    titlenum smallint not null,
    title char(60),
    min char(1)
  );
revoke all on "card".clrtitle from "public";

{ TABLE "card".crewtitl row size = 8 number of columns = 4 index size = 0 }
{ unload file name = crewtit116.unl number of rows = 32 }

create table "card".crewtitl
  (
    anum smallint not null,
    crewstan smallint not null,
    titlenum smallint not null,
    fmttype smallint
  );
revoke all on "card".crewtitl from "public";

{ TABLE "card".typetwo row size = 70 number of columns = 11 index size = 0 }
{ unload file name = typetwo117.unl number of rows = 2 }

create table "card".typetwo
  (
    anum smallint not null,
    titlenum smallint not null,
    crewstan smallint not null,
    linemnum smallint,
    linemval decimal(16),
    mnum smallint,
    lowval decimal(16),
    lowclr decimal(16),
    upval decimal(16),
    upclr decimal(16),
    degsubt decimal(16)
  );
revoke all on "card".typetwo from "public";

{ TABLE "card".clrnote row size = 8 number of columns = 4 index size = 0 }
{ unload file name = clrnote118.unl number of rows = 10 }
```

```
create table "card".clrnote
  (
    anum smallint not null,
    titlenum smallint not null,
    crewstan smallint not null,
    cnotenum smallint
  );
revoke all on "card".clrnote from "public";

{ TABLE "card".mname row size = 37 number of columns = 2 index size = 0 }
{ unload file name = mname__119.unl number of rows = 4 }

create table "card".mname
  (
    mnum smallint not null,
    mname char(35)
  );
revoke all on "card".mname from "public";

{ TABLE "card".linemnam row size = 37 number of columns = 2 index size = 0 }
{ unload file name = linemna120.unl number of rows = 1 }

create table "card".linemnam
  (
    linemnum smallint not null,
    linemnam char(35)
  );
revoke all on "card".linemnam from "public";

{ TABLE "card".region row size = 32 number of columns = 2 index size = 0 }
{ unload file name = region_121.unl number of rows = 12 }

create table "card".region
  (
    regnum smallint not null,
    region char(30)
  );
revoke all on "card".region from "public";

{ TABLE "card".vnote row size = 122 number of columns = 2 index size = 0 }
{ unload file name = vnote__122.unl number of rows = 1 }

create table "card".vnote
  (
    vnotenum smallint not null,
    vnote char(120)
  );
revoke all on "card".vnote from "public";

{ TABLE "card".cnote row size = 122 number of columns = 2 index size = 0 }
{ unload file name = cnote__123.unl number of rows = 5 }

create table "card".cnote
  (
    cnotenum smallint not null,
    cnote char(120)
  );
revoke all on "card".cnote from "public";

{ TABLE "card".rnote row size = 122 number of columns = 2 index size = 0 }
{ unload file name = rnote__124.unl number of rows = 0 }

create table "card".rnote
  (
    rnotenum smallint not null,
    rnote char(120)
```

```
  );
revoke all on "card".rnote from "public";

{ TABLE "card".vision row size = 78 number of columns = 11 index size = 0 }
{ unload file name = vision_125.unl number of rows = 60 }

create table "card".vision
  (
    anum smallint not null,
    viewnum smallint not null,
    headposn smallint not null,
    crewstan smallint not null,
    mineht decimal(16),
    minvdeg decimal(16),
    maxeht decimal(16),
    maxvdeg decimal(16),
    abvglare decimal(16),
    glareht decimal(16),
    blwglare decimal(16)
  );
revoke all on "card".vision from "public";

{ TABLE "card".crewreg row size = 6 number of columns = 3 index size = 0 }
{ unload file name = crewreg126.unl number of rows = 58 }

create table "card".crewreg
  (
    anum smallint not null,
    crewstan smallint not null,
    regnum smallint
  );
revoke all on "card".crewreg from "public";

{ TABLE "card".visadj row size = 18 number of columns = 5 index size = 0 }
{ unload file name = visadj_127.unl number of rows = 16 }

create table "card".visadj
  (
    anum smallint not null,
    viewnum smallint not null,
    headposn smallint not null,
    crewstan smallint not null,
    adjdeg decimal(16)
  );
revoke all on "card".visadj from "public";

{ TABLE "card".typeone row size = 30 number of columns = 7 index size = 0 }
{ unload file name = typeone128.unl number of rows = 58 }

create table "card".typeone
  (
    anum smallint not null,
    titlenum smallint not null,
    crewstan smallint not null,
    seatpos smallint not null,
    mnum smallint,
    mval decimal(16),
    clrchng decimal(16)
  );
revoke all on "card".typeone from "public";

{ TABLE "card".aircraft row size = 12 number of columns = 3 index size = 0 }
{ unload file name = aircraf129.unl number of rows = 5 }

create table "card".aircraft
  (
```

```
     anum smallint not null,
     catnum smallint,
     aname char(8)
   );
 revoke all on "card".aircraft from "public";



 grant select on "card".airdesc to "public" as "card";
 grant update on "card".airdesc to "public" as "card";
 grant insert on "card".airdesc to "public" as "card";
 grant delete on "card".airdesc to "public" as "card";
 grant index on "card".airdesc to "public" as "card";
 grant select on "card".catname to "public" as "card";
 grant update on "card".catname to "public" as "card";
 grant insert on "card".catname to "public" as "card";
 grant delete on "card".catname to "public" as "card";
 grant index on "card".catname to "public" as "card";
 grant select on "card".crewsta to "public" as "card";
 grant update on "card".crewsta to "public" as "card";
 grant insert on "card".crewsta to "public" as "card";
 grant delete on "card".crewsta to "public" as "card";
 grant index on "card".crewsta to "public" as "card";
 grant select on "card".aircrew to "public" as "card";
 grant update on "card".aircrew to "public" as "card";
 grant insert on "card".aircrew to "public" as "card";
 grant delete on "card".aircrew to "public" as "card";
 grant index on "card".aircrew to "public" as "card";
 grant select on "card".airreg to "public" as "card";
 grant update on "card".airreg to "public" as "card";
 grant insert on "card".airreg to "public" as "card";
 grant delete on "card".airreg to "public" as "card";
 grant index on "card".airreg to "public" as "card";
 grant select on "card".control to "public" as "card";
 grant update on "card".control to "public" as "card";
 grant insert on "card".control to "public" as "card";
 grant delete on "card".control to "public" as "card";
 grant index on "card".control to "public" as "card";
 grant select on "card".crewcont to "public" as "card";
 grant update on "card".crewcont to "public" as "card";
 grant insert on "card".crewcont to "public" as "card";
 grant delete on "card".crewcont to "public" as "card";
 grant index on "card".crewcont to "public" as "card";
 grant select on "card".seatadj to "public" as "card";
 grant update on "card".seatadj to "public" as "card";
 grant insert on "card".seatadj to "public" as "card";
 grant delete on "card".seatadj to "public" as "card";
 grant index on "card".seatadj to "public" as "card";
 grant select on "card".visnote to "public" as "card";
 grant update on "card".visnote to "public" as "card";
 grant insert on "card".visnote to "public" as "card";
 grant delete on "card".visnote to "public" as "card";
 grant index on "card".visnote to "public" as "card";
 grant select on "card".reach to "public" as "card";
 grant update on "card".reach to "public" as "card";
 grant insert on "card".reach to "public" as "card";
 grant delete on "card".reach to "public" as "card";
 grant index on "card".reach to "public" as "card";
 grant select on "card".rchnote to "public" as "card";
 grant update on "card".rchnote to "public" as "card";
 grant insert on "card".rchnote to "public" as "card";
 grant delete on "card".rchnote to "public" as "card";
 grant index on "card".rchnote to "public" as "card";
 grant select on "card".view to "public" as "card";
 grant update on "card".view to "public" as "card";
 grant insert on "card".view to "public" as "card";
```

```
grant delete on "card".view to "public" as "card";
grant index on "card".view to "public" as "card";
grant select on "card".crewview to "public" as "card";
grant update on "card".crewview to "public" as "card";
grant insert on "card".crewview to "public" as "card";
grant delete on "card".crewview to "public" as "card";
grant index on "card".crewview to "public" as "card";
grant select on "card".clrtitle to "public" as "card";
grant update on "card".clrtitle to "public" as "card";
grant insert on "card".clrtitle to "public" as "card";
grant delete on "card".clrtitle to "public" as "card";
grant index on "card".clrtitle to "public" as "card";
grant select on "card".crewtitl to "public" as "card";
grant update on "card".crewtitl to "public" as "card";
grant insert on "card".crewtitl to "public" as "card";
grant delete on "card".crewtitl to "public" as "card";
grant index on "card".crewtitl to "public" as "card";
grant select on "card".typetwo to "public" as "card";
grant update on "card".typetwo to "public" as "card";
grant insert on "card".typetwo to "public" as "card";
grant delete on "card".typetwo to "public" as "card";
grant index on "card".typetwo to "public" as "card";
grant select on "card".clrnote to "public" as "card";
grant update on "card".clrnote to "public" as "card";
grant insert on "card".clrnote to "public" as "card";
grant delete on "card".clrnote to "public" as "card";
grant index on "card".clrnote to "public" as "card";
grant select on "card".mname to "public" as "card";
grant update on "card".mname to "public" as "card";
grant insert on "card".mname to "public" as "card";
grant delete on "card".mname to "public" as "card";
grant index on "card".mname to "public" as "card";
grant select on "card".linemnam to "public" as "card";
grant update on "card".linemnam to "public" as "card";
grant insert on "card".linemnam to "public" as "card";
grant delete on "card".linemnam to "public" as "card";
grant index on "card".linemnam to "public" as "card";
grant select on "card".region to "public" as "card";
grant update on "card".region to "public" as "card";
grant insert on "card".region to "public" as "card";
grant delete on "card".region to "public" as "card";
grant index on "card".region to "public" as "card";
grant select on "card".vnote to "public" as "card";
grant update on "card".vnote to "public" as "card";
grant insert on "card".vnote to "public" as "card";
grant delete on "card".vnote to "public" as "card";
grant index on "card".vnote to "public" as "card";
grant select on "card".cnote to "public" as "card";
grant update on "card".cnote to "public" as "card";
grant insert on "card".cnote to "public" as "card";
grant delete on "card".cnote to "public" as "card";
grant index on "card".cnote to "public" as "card";
grant select on "card".rnote to "public" as "card";
grant update on "card".rnote to "public" as "card";
grant insert on "card".rnote to "public" as "card";
grant delete on "card".rnote to "public" as "card";
grant index on "card".rnote to "public" as "card";
grant select on "card".vision to "public" as "card";
grant update on "card".vision to "public" as "card";
grant insert on "card".vision to "public" as "card";
grant delete on "card".vision to "public" as "card";
grant index on "card".vision to "public" as "card";
grant select on "card".crewreg to "public" as "card";
grant update on "card".crewreg to "public" as "card";
grant insert on "card".crewreg to "public" as "card";
grant delete on "card".crewreg to "public" as "card";
```

```
grant index on "card".crewreg to "public" as "card";
grant select on "card".visadj to "public" as "card";
grant update on "card".visadj to "public" as "card";
grant insert on "card".visadj to "public" as "card";
grant delete on "card".visadj to "public" as "card";
grant index on "card".visadj to "public" as "card";
grant select on "card".typeone to "public" as "card";
grant update on "card".typeone to "public" as "card";
grant insert on "card".typeone to "public" as "card";
grant delete on "card".typeone to "public" as "card";
grant index on "card".typeone to "public" as "card";
grant select on "card".aircraft to "public" as "card";
grant update on "card".aircraft to "public" as "card";
grant insert on "card".aircraft to "public" as "card";
grant delete on "card".aircraft to "public" as "card";
grant index on "card".aircraft to "public" as "card";
```

```
#define MAX_AIRCRAFT 500
#define MAX_CATEGORIES 25
#define MAX_CLEARANCE_TYPES 10
#define MAX_CONTROLS 200
#define MAX_CREWSTATIONS 50
#define MAX_REGIONS 50

typedef struct _aircraft_category
{
        int  catNumber[MAX_CATEGORIES];
        char *catName[MAX_CATEGORIES];
}AircraftCategory;

typedef struct _console_region
{
        int  regionNumber[MAX_REGIONS];
        char *regionName[MAX_REGIONS];
}ConsoleRegion;

typedef struct _clearance_type
{
        int  clearNumber[MAX_CLEARANCE_TYPES];
        char *clearMinimum[MAX_CLEARANCE_TYPES];
        char *clearTitle[MAX_CLEARANCE_TYPES];
}ClearanceType;

typedef struct _vertical_seat_position_data
{
        int   seatAdjustsVertical[MAX_AIRCRAFT];      /* 0 = no     1 = yes    */
        int   vertSeatUnits[MAX_AIRCRAFT];            /* 0 = notch 2 = inches */ ♦
        int   vertSeatNumberOfIncrements[MAX_AIRCRAFT];
        float vertSeatTotalAdj[MAX_AIRCRAFT];
        float vertSeatMaxAdj[MAX_AIRCRAFT];
        float vertSeatAdjIncrements[MAX_AIRCRAFT];
}VerticalSeatData;

typedef struct _horizontal_seat_position_data
{
        int   seatAdjustsHorizontal[MAX_AIRCRAFT];   /* 0 = no     1 = yes    */
        int   horzSeatUnits[MAX_AIRCRAFT];            /* 0 = notch 1 = inches */
        int   horzSeatNumberOfIncrements[MAX_AIRCRAFT];
        float horzSeatTotalAdj[MAX_AIRCRAFT];
        float horzSeatMaxAdj[MAX_AIRCRAFT];
        float    horzSeatAdjIncrements[MAX_AIRCRAFT];
}HorizontalSeatData;

typedef struct _console_controls
{
        int aircraftControl[MAX_AIRCRAFT][MAX_CREWSTATIONS][MAX_CONTROLS];
        int numberControlsThisAircraft[MAX_AIRCRAFT][MAX_CREWSTATIONS];
}ConsoleControls;
```

```
#include <stdio.h>
#include <string.h>
#include "aircraft.h"

EXEC SQL include sqlca;
EXEC SQL include sqlda;

AircraftCategory Category;
ConsoleRegion Console;
ClearanceType ClearType;
VerticalSeatData VertSeat;
HorizontalSeatData HorzSeat;
ConsoleControls Controls;

/* Declare the host variables for database queries */

EXEC SQL BEGIN DECLARE SECTION;

short i;
short ind,ind2;                 /* indexes from the database */
short field;
short desc_Count;
char *query_String;
char tempname[60];

EXEC SQL END DECLARE SECTION;

main()
{

/* Open the cockpit database */

        EXEC SQL database cockpit;

        getAircraftCategory();
        getConsoleRegion();
        getClearanceType();
        getSeatData();
        getConsoleControls();

}

void getAircraftCategory()
{
        register i;

/* Set up the query to the database */

        query_String = "select * from catname";

/* Define the descriptor for database access */

        EXEC SQL prepare qid from $query_String;
        EXEC SQL declare query_Cursor cursor for qid;
        EXEC SQL allocate descriptor 'queryDesc';

        EXEC SQL open query_Cursor;
        EXEC SQL describe qid using sql descriptor 'queryDesc';
        EXEC SQL get descriptor 'queryDesc' $desc_Count = count;

        for (i=1; i<= desc_Count; i++)
                prsqlda(i);

        for (;;)
        {
                EXEC SQL fetch query_Cursor using sql descriptor 'queryDesc';
```

```
            if (sqlca.sqlcode != 0) break;

            for (field = 1; field<= desc_Count; field++)
            {
            switch(field)
            {
            case 1:         /* catnum: category number */

                    EXEC SQL get descriptor 'queryDesc' value $field
                            $ind = data;
                    Category.catNumber[ind] = ind;
                    printf("catnum: %d ",Category.catNumber[ind]);
                    break;

            case 2:         /* catname: category name */
                    EXEC SQL get descriptor 'queryDesc' value $field
                            $tempname = data;
                    Category.catName[ind] = tempname;
                    printf("   %s\n",Category.catName[ind]);
                    break;
            }

            }
        }

        EXEC SQL close query_Cursor;

}

void getConsoleRegion()
{
        register i;

/* Set up the query to the database */

        query_String = "select * from region";

/* Define the descriptor for database access */

        EXEC SQL prepare qid1 from $query_String;
        EXEC SQL declare query_Cursor1 cursor for qid1;
        EXEC SQL allocate descriptor 'queryDesc';

        EXEC SQL open query_Cursor1;
        EXEC SQL describe qid1 using sql descriptor 'queryDesc';
        EXEC SQL get descriptor 'queryDesc' $desc_Count = count;

        for (i=1; i<= desc_Count; i++)
                prsqlda(i);

        for (;;)
        {
                EXEC SQL fetch query_Cursor1 using sql descriptor 'queryDesc';

                if (sqlca.sqlcode != 0) break;

                for (field = 1; field<= desc_Count; field++)
                {
                switch(field)
                {
                case 1:         /* regnum: region number */

                        EXEC SQL get descriptor 'queryDesc' value $field
                                $ind = data;
                        Console.regionNumber[ind] = ind;
```

```
                    printf("regnum: %d ",Console.regionNumber[ind]);
                    break;

            case 2:         /* catname: category name */
                    EXEC SQL get descriptor 'queryDesc' value $field
                            $tempname = data;
                    Console.regionName[ind] = tempname;
                    printf("   %s\n",Console.regionName[ind]);
                    break;
            }

            }
        }

        EXEC SQL close query_Cursor;

}

void getClearanceType()
{
        register i;

/* Set up the query to the database */

        query_String = "select * from clrtitle";

/* Define the descriptor for database access */

        EXEC SQL prepare qid2 from $query_String;
        EXEC SQL declare query_Cursor2 cursor for qid2;
        EXEC SQL allocate descriptor 'queryDesc';

        EXEC SQL open query_Cursor2;
        EXEC SQL describe qid2 using sql descriptor 'queryDesc';
        EXEC SQL get descriptor 'queryDesc' $desc_Count = count;

        for (i=1; i<= desc_Count; i++)
                prsqlda(i);

        for (;;)
        {
                EXEC SQL fetch query_Cursor2 using sql descriptor 'queryDesc';

                if (sqlca.sqlcode != 0) break;

                for (field = 1; field<= desc_Count; field++)
                {
                switch(field)
                {
                case 1:         /* titlenum: clearance title number */

                        EXEC SQL get descriptor 'queryDesc' value $field
                                $ind = data;
                        ClearType.clearNumber[ind] = ind;
                        printf("clearNumber:  %d ",ClearType.clearNumber[ind]);
                        break;

                case 2:         /* title: clearance title */
                        EXEC SQL get descriptor 'queryDesc' value $field
                                $tempname = data;
                        ClearType.clearTitle[ind] = tempname;
                        printf("   %s",ClearType.clearTitle[ind]);
                        break;

                case 3:         /* min: clearance minimum? y/n */
```

```
                    EXEC SQL get descriptor 'queryDesc' value $field
                         $tempname = data;
                    ClearType.clearMinimum[ind] = tempname;
                    printf("   %s\n",ClearType.clearMinimum[ind]);
                    break;




        EXEC SQL close query_Cursor;

}

void getSeatData()
{
        register i;

        EXEC SQL BEGIN DECLARE SECTION;

        char seatDir[2]; /* seat adj direction, v=vertical, h=horizontal */
        short adjType;   /* seat adj type, 0=notches, 1=inches */
        short anum;      /* aircraft id number */
        float adjInc;    /* distance between each seat increment in inches */
        float maxAdj;    /* total seat travel in inches */

        EXEC SQL END DECLARE SECTION;

/* Set up the query to the database */

        query_String = "select * from seatadj";

/* Define the descriptor for database access */

        EXEC SQL prepare qid3 from $query_String;
        EXEC SQL declare query_Cursor3 cursor for qid3;
        EXEC SQL allocate descriptor 'queryDesc';

        EXEC SQL open query_Cursor3;
        EXEC SQL describe qid3 using sql descriptor 'queryDesc';
        EXEC SQL get descriptor 'queryDesc' $desc_Count = count;

        for (i=1; i<= desc_Count; i++)
                prsqlda(i);

        for (;;)
        {

                EXEC SQL fetch query_Cursor3 using sql descriptor 'queryDesc';

                if (sqlca.sqlcode != 0) break;

                for (field = 1; field <= desc_Count; field ++)
                {

                switch(field)

                {
                case 1:          /* anum: aircraft number */

                        EXEC SQL get descriptor 'queryDesc' value $field
                             $anum = data;
                        break;

                case 2:
```

```
                        EXEC SQL get descriptor 'queryDesc' value $field
                                $seatDir = data;
                        break;

                case 3:         /* adjInc: adj increment */

                        EXEC SQL get descriptor 'queryDesc' value $field
                                $adjInc = data;
                        break;

                case 4:         /* maxAdj: adj increment */

                        EXEC SQL get descriptor 'queryDesc' value $field
                                $maxAdj = data;
                        break;
                case 5:         /* adjType: type of adj */

                        EXEC SQL get descriptor 'queryDesc' value $field
                                $adjType = data;
                        break;

                }


                }

/* set the vertical/horizontal flags for each aircraft, figure out the
   number of notches */

                if (strcmp(seatDir,"V") == 0)
                {
                        VertSeat.seatAdjustsVertical[anum] = 1;
                        VertSeat.vertSeatUnits[anum] = adjType;
                        VertSeat.vertSeatTotalAdj[anum] = maxAdj;
                        VertSeat.vertSeatAdjIncrements[anum] = adjInc;
                        VertSeat.vertSeatNumberOfIncrements[anum] = maxAdj/adjInc;
                }
                else
                {
                        VertSeat.seatAdjustsVertical[anum] = 0;
                }

                if (strcmp(seatDir,"H") == 0)
                {
                        HorzSeat.seatAdjustsHorizontal[anum] = 1;
                        HorzSeat.horzSeatUnits[anum] = adjType;
                        HorzSeat.horzSeatTotalAdj[anum] = maxAdj;
                        HorzSeat.horzSeatAdjIncrements[anum] = adjInc;
                        HorzSeat.horzSeatNumberOfIncrements[anum] = maxAdj/adjInc;
                }
                else
                {
                        HorzSeat.seatAdjustsHorizontal[anum] = 0;
                }

if (VertSeat.seatAdjustsVertical[anum])
{
printf("\n Seat adjustment data for %d \n",anum);
printf("seatAdjustsVertical: %d \n",VertSeat.seatAdjustsVertical[anum]);
printf("vertSeatUnits: %d\n",VertSeat.vertSeatUnits[anum]);
printf("vertSeatTotalAdj: %f\n",VertSeat.vertSeatTotalAdj[anum]);
printf("vertSeatAdjIncrements: %f\n",VertSeat.vertSeatAdjIncrements[anum]);
printf("vertSeatNumberOfIncrements: %d\n",VertSeat.vertSeatNumberOfIncrements[anum]
}

if (HorzSeat.seatAdjustsHorizontal[anum])
```

```
{
printf("\n Seat adjustment data for %d \n",anum);
printf("seatAdjustsHorizontal: %d \n",HorzSeat.seatAdjustsHorizontal[anum]);
printf("horzSeatUnits: %d\n",HorzSeat.horzSeatUnits[anum]);
printf("horzSeatTotalAdj: %f\n",HorzSeat.horzSeatTotalAdj[anum]);
printf("horzSeatAdjIncrements: %f\n",HorzSeat.horzSeatAdjIncrements[anum]);
printf("horzSeatNumberOfIncrements: %d\n",HorzSeat.horzSeatNumberOfIncrements[anum]
}

        }

        EXEC SQL close query_Cursor3;

}

void getConsoleControls()
{

register i,j;

EXEC SQL BEGIN DECLARE SECTION;

short control_number;
int   ind3;

EXEC SQL END DECLARE SECTION;


/* Set up the query to the database */

        query_String = "select * from crewcont";

/* Define the descriptor for database access */


        EXEC SQL prepare qid4 from $query_String;
        EXEC SQL declare query_Cursor4 cursor for qid4;
        EXEC SQL allocate descriptor 'queryDesc';

        EXEC SQL open query_Cursor4;
        EXEC SQL describe qid4 using sql descriptor 'queryDesc';
        EXEC SQL get descriptor 'queryDesc' $desc_Count = count;

        for (i=1; i<= desc_Count; i++)
                prsqlda(i);

        for (;;)
        {
                EXEC SQL fetch query_Cursor4 using sql descriptor 'queryDesc';

                if (sqlca.sqlcode != 0) break;

                for (field = 1; field<= desc_Count; field++)
                {
                switch(field)
                {
                case 1:         /* anum: aircraft number */

                        EXEC SQL get descriptor 'queryDesc' value $field
                                $ind = data;
                        break;

                case 2:         /* crewstan: crewstation number */
                        EXEC SQL get descriptor 'queryDesc' value $field
                                $ind2 = data;
                        break;
```

```
            case 3:         /* contnum: control number */

                    EXEC SQL get descriptor 'queryDesc' value $field
                            $control_number = data;
                    break;
            }

            }

            ++Controls.numberOfControls[ind][ind2] ;
            ind3 = Controls.numberOfControls[ind][ind2];
            Controls.aircraftControl[ind][ind2][ind3] = control_number;

            printf("anum: %d crew: %d control: %d\n",ind,ind2,
                    Controls.aircraftControl[ind][ind2][ind3]);

        }

            for (i=1;i<=3;i++)
            {
               for (j=1; j<=2; j++)
               {
                    printf("# of controls: [ %d ][ %d ] = %d\n",i,j,
               }
            }

        EXEC SQL close query_Cursor4;

}


prsqlda(index)

EXEC SQL BEGIN DECLARE SECTION;

parameter int index;

EXEC SQL END DECLARE SECTION;

{

EXEC SQL BEGIN DECLARE SECTION;
        int type;
        int len;
        char name[40];
EXEC SQL END DECLARE SECTION;

        EXEC SQL get descriptor 'queryDesc' value $index $type = type,
                $len = length, $name = name;

/*      printf ("  Column %d: type = %d:, len = %d, name = %s\n",
                index, type, len, name); */
}
```

```
#include <stdio.h>
#include <string.h>
#include "aircraft.h"
#include "typedefs.h"
#include "constants.h"

FitData indata;
VerticalSeatData VertSeat;
HorizontalSeatData HorzSeat;

compute_F16_SeatAdj()
{
float maxSitHtFulldown[4] = {40.5, 39.5, 38.5, 37.5};
float maxSitHtFullup[4] = {36.2, 35.2, 34.2, 33.2};
float sittingHeightRange;

/* initially the seat position is set at full-down */

/********this variable set for testing **************/
        VertSeat.vertSeatNumberOfIncrements[F_16_A] = 50;

        indata.vertSeatPosition = 0;

        sittingHeightRange = (maxSitHtFulldown[indata.clearanceOverhead-1] -
                              maxSitHtFullup[indata.clearanceOverhead-1]) /
                              VertSeat.vertSeatNumberOfIncrements[F_16_A];

/* Determine the seat position. If the sitting height is less than the
   minimum at the clearance value requested, the subject sits at fullup.
   If the sitting height is greater than the maximum at the clearance value
   requested, the subject sits at fulldown. Otherwise calculate where the
   seat should be positioned. */

        if ( indata.sittingHeight <=
                        maxSitHtFullup[indata.clearanceOverhead-1])

                indata.vertSeatPosition =
                                VertSeat.vertSeatNumberOfIncrements[F_16_A];

        else if (indata.sittingHeight >=
                                maxSitHtFulldown[indata.clearanceOverhead-1])

                indata.vertSeatPosition = 0;
        else

                indata.vertSeatPosition =
                        (maxSitHtFulldown[indata.clearanceOverhead-1] -
                        indata.sittingHeight) / sittingHeightRange;
}


compute_T37_SeatAdj()
{
float maxSitHtFulldown = 40.0;
float seatAdj;

/* initially the seat position is set at full-down */

        indata.vertSeatPosition = 0;

        VertSeat.vertSeatAdjIncrements[T_37_B] = .625;
        VertSeat.vertSeatNumberOfIncrements[T_37_B] = 8;

        seatAdj = ( ( maxSitHtFulldown -
                (indata.clearanceOverhead - 1) ) - indata.sittingHeight) /
                VertSeat.vertSeatAdjIncrements[T_37_B];
```

```
/* Determine the seat position. If the sitting height is less than the
   minimum at the clearance value requested, the subject sits at fullup.
   If the sitting height is greater than the maximum at the clearance value
   requested, the subject sits at fulldown. Otherwise calculate where the
   seat should be positioned. */

        if ( seatAdj >= VertSeat.vertSeatNumberOfIncrements[T_37_B] )

              indata.vertSeatPosition =
                        VertSeat.vertSeatNumberOfIncrements[T_37_B];

        else if ( seatAdj <= 0 )

              indata.vertSeatPosition = 0;

        else

              indata.vertSeatPosition = seatAdj + .5;

}

compute_T1A_SeatAdj()
{
float maxSitHtFulldown = 42.6;
float seatAdj;

/* initially the seat position is set at full-down, full-forward */

        indata.vertSeatPosition = 0;
        indata.horzSeatPosition = 0;

        VertSeat.vertSeatAdjIncrements[T_1_A] = .75;
        VertSeat.vertSeatNumberOfIncrements[T_1_A] = 6;

        seatAdj = ( ( maxSitHtFulldown -
                (indata.clearanceOverhead - 1) ) - indata.sittingHeight) /
                VertSeat.vertSeatAdjIncrements[T_1_A];

/* Determine the seat position. If the sitting height is less than the
   minimum at the clearance value requested, the subject sits at fullup.
   If the sitting height is greater than the maximum at the clearance value
   requested, the subject sits at fulldown. Otherwise calculate where the
   seat should be positioned. */

        if ( seatAdj >= VertSeat.vertSeatNumberOfIncrements[T_1_A] )

              indata.vertSeatPosition =
                        VertSeat.vertSeatNumberOfIncrements[T_1_A];

        else if ( seatAdj <= 0 )

              indata.vertSeatPosition = 0;

        else

              indata.vertSeatPosition = seatAdj + .5;
}
compute_T38A_SeatAdj()
{
float maxSitHtFulldown[2] = {45.0,39.5};
float maxDown;
float clearanceFactor = 1.11;
float seatAdj;

/* initially the seat position is set at full-down, full-forward */
```

```
        indata.vertSeatPosition = 0;

        VertSeat.vertSeatTotalAdj[T_38_A] = 5.0;
        VertSeat.vertSeatNumberOfIncrements[T_38_A] = 50;

        if (indata.selectedCrewStations[1] == CREW_FORWARD)
                maxDown = maxSitHtFulldown[0];

        else if (indata.selectedCrewStations[1] == CREW_AFT)
                maxDown = maxSitHtFulldown[1];

        seatAdj = ( maxDown - indata.sittingHeight) /
                  ( indata.clearanceOverhead * clearanceFactor);

/* Determine the seat position. If the sitting height is less than the
   minimum at the clearance value requested, the subject sits at fullup.
   If the sitting height is greater than the maximum at the clearance value
   requested, the subject sits at fulldown. Otherwise calculate where the
   seat should be positioned. */

        if ( seatAdj >= VertSeat.vertSeatTotalAdj[T_38_A] )

              indata.vertSeatPosition =
                        VertSeat.vertSeatNumberOfIncrements[T_38_A];

        else if ( seatAdj <= 0 )

              indata.vertSeatPosition = 0;

        else

              indata.vertSeatPosition = seatAdj *10;
}
```

```
#include <stdio.h>
#include <string.h>
#include "aircraft.h"
#include "typedefs.h"
#include "constants.h"

EXEC SQL include sqlca;
EXEC SQL include sqlda;

FitData indata;
VerticalSeatData VertSeat;
HorizontalSeatData HorzSeat;

/* Declare the host variables for database queries */

EXEC SQL BEGIN DECLARE SECTION;

short i;
short ind,ind2;                /* indexes from the database */
short field;
short desc_Count;
char *crewview_Query;
char *view_Query;
char *vision_Query;
char *visnote_Query;
char *vnote_Query;
char tempname[60];

EXEC SQL END DECLARE SECTION;

main()
{

/* Open the cockpit database */

        EXEC SQL database cockpit;

}

void calculate_vision()
{

EXEC SQL BEGIN DECLARE SECTION;

short aircraftNumber,crewNumber,headPosition;
short viewNumber,headPositionCnt;
short viewNoteNumber[2];
char view[60];
char vnote1[120],vnote2[120];

EXEC SQL END DECLARE SECTION;

float slope,intercept;         /* slope and intercept of line */
float adjvis,degvis[2];        /* degrees of vision */
float adjdeg;                  /* c-141 */

float minimumEyeHt[2];         /* minimum eyeht */
float maximumEyeHt[2];         /* maximum eyeht */
float minimumVisionDeg[2];     /* minimum degree of vision */
float maximumVisionDeg[2];     /* maximum degree of vision */

float aboveGlare[2]            /* degree change above glare shield */
float glareHeight[2]           /* glare shield height */
float belowGlare[2]            /* degree change below glare shield */

float rangeMaxEyeHt[2];        /* maximum eyeht for range data */
```

```
float rangeMinEyeHt[2];          /* minimum eyeht for range data */
float minEyeHtDeg[2][2];         /* minimum degree of vision for eyeht */
float maxEyeHtDeg[2][2];         /* maximum degree of vision for eyeht */

/* only perform vision calculations when subject eye-ht-sitting is available */

if ( eyeHeightSitting >= 0.0)
{

/* Set up the query to the database */

        crewview_Query = "select * from crewview where anum =
        indata.selectedAircraft[1] and crewstan =
        indata.selectedCrewStations[1]";

/* Define the descriptor for database access */

        EXEC SQL prepare qid from $crewview_Query;
        EXEC SQL declare query_Cursor cursor for qid;
        EXEC SQL allocate descriptor 'queryDesc';

        EXEC SQL open query_Cursor;
        EXEC SQL describe qid using sql descriptor 'queryDesc';
        EXEC SQL get descriptor 'queryDesc' $desc_Count = count;

        for (i=1; i<= desc_Count; i++)
                prsqlda(i);

        for (;;)
        {
           EXEC SQL fetch query_Cursor using sql descriptor 'queryDesc';

           if (sqlca.sqlcode != 0) break;

           for (field = 1; field<= desc_Count; field++)
           {
                switch(field)
                {

                case 1:         /* anum: aircraft number */

                EXEC SQL get descriptor 'queryDesc' value $field
                                $aircraftNumber = data;
                printf("anum: %d ",aircraftNumber);
                break;

                case 2:         /* crewstan: crewstation number */

                EXEC SQL get descriptor 'queryDesc' value $field
                                $crewNumber = data;
                printf("crewstan:  %d\n",crewNumber);
                break;

                case 3:         /* viewnum: view number */

                EXEC SQL get descriptor 'queryDesc' value $field
                                $viewNumber = data;
                printf("viewNumber:  %d\n",viewNumber);
                break;
                }

           }

/* Set up the query to the database */

        view_Query = "select * from view where viewnum = viewNumber";
```

```
/* Define the descriptor for database access */

        EXEC SQL prepare qid1 from $view_Query;
        EXEC SQL declare query_Cursor1 cursor for qid1;
        EXEC SQL allocate descriptor 'queryDesc';

        EXEC SQL open query_Cursor1;
        EXEC SQL describe qid1 using sql descriptor 'queryDesc';
        EXEC SQL get descriptor 'queryDesc' $desc_Count = count;

        for (i=1; i<= desc_Count; i++)
                prsqlda(i);

        for (;;)
        {
           EXEC SQL fetch query_Cursor using sql descriptor 'queryDesc';

           if (sqlca.sqlcode != 0) break;

           for (field = 1; field<= desc_Count; field++)
           {
                switch(field)
                {

                case 1:         /* viewnum: view number */

                printf("viewNumber: %d ",viewNumber);
                break;

                case 2:         /* view: view title */

                EXEC SQL get descriptor 'queryDesc' value $field
                                $view = data;
                printf("viewTitle:  %s\n",view);
                break;

                }

           }

/* Set up the query to the database */

        vision_Query = "select * from vision where anum =
        indata.selectedAircraft[1] and crewstan =
        indata.selectedCrewStations[1] and viewnum = viewNumber";

/* Define the descriptor for database access */

        EXEC SQL prepare qid3 from $vision_Query;
        EXEC SQL declare query_Cursor3 cursor for qid3;
        EXEC SQL allocate descriptor 'queryDesc';

        EXEC SQL open query_Cursor3;
        EXEC SQL describe qid3 using sql descriptor 'queryDesc';
        EXEC SQL get descriptor 'queryDesc' $desc_Count = count;

        for (i=1; i<= desc_Count; i++)
                prsqlda(i);

        for (;;)
        {
           EXEC SQL fetch query_Cursor using sql descriptor 'queryDesc';

           if (sqlca.sqlcode != 0) break;
```

```
    for (field = 1; field<= desc_Count; field++)
    {
         switch(field)
         {

         case 1:          /*`anum: aircraft number */

         EXEC SQL get descriptor 'queryDesc' value $field
                          $aircraftNumber = data;
         printf("anum: %d ",aircraftNumber);
         break;

         case 2:          /* crewstan: crewstation number */

         EXEC SQL get descriptor 'queryDesc' value $field
                          $crewNumber = data;
         printf("crewstan:  %d\n",crewNumber);
         break;

         case 3:          /* viewnum: view number */

         EXEC SQL get descriptor 'queryDesc' value $field
                          $viewNumber = data;
         printf("viewNumber:  %d\n",viewNumber);
         break;
         }

    }




}        /* for (;;)  */




}        /* for (;;)  */
```

APPENDIX F

GUI SOURCE FILES

buildmenu.c

```
/*****************************************************************
 *  BuildMenu.c                                                   *
 *  Used to build popup, option, pulldown and pullright menus.    *
 *  Menus are defined by declaring an array of MenuItem structures *
 *****************************************************************/

#include <Xm/RowColumn.h>
/* #include <Xm/CascadeB.h>*/
#include <Xm/CascadeBG.h>
#include <Xm/ToggleB.h>
#include <Xm/ToggleBG.h>
#include <Xm/PushB.h>
#include <Xm/PushBG.h>
#include "typedefs.h"
#include "constants.h"

extern void SetWidgetColorScheme();

/*****************************************************************
 *  Build popup, option and pulldown menus, depending on the      *
 *  menu_type.  It may be XmMENU_PULLDOWN, XmMENU_OPTION, or      *
 *  XmMENU_POPUP.  Pulldowns return the CascadeButton that pops up *
 *  the menu.  Popups return the menu.  Option menus are created, *
 *  but the RowColumn that acts as the option "area" is returned  *
 *  unmanaged.  (The user must manage it.)  Pulldown menus are    *
 *  built from cascade buttons, so this function also builds      *
 *  pullright menus.  The function also adds the right callback for *
 *  PushButton or ToggleButton menu items.                        *
 *****************************************************************/

Widget BuildMenu(parent, menu_type, menu_title, menu_mnemonic, items)

Widget parent;
int menu_type;
char *menu_title, menu_mnemonic;
MenuItem *items;

{
    Widget menu, cascade, widget;
    int i;
    XmString str;

    if (menu_type == XmMENU_PULLDOWN || menu_type == XmMENU_OPTION)
    {
        menu = XmCreatePulldownMenu(parent, "_pulldown", NULL, 0);
    }
    else if (menu_type == XmMENU_POPUP)
        menu = XmCreatePopupMenu(parent, "_popup", NULL, 0);
    else
    {
        XtWarning("Invalid menu type passed to BuildMenu()");
        return NULL;
    }

    SetWidgetColorScheme(menu, dialogSectionTitleColor);
    /* Pulldown menus require a cascade button to be made */
    if (menu_type == XmMENU_PULLDOWN)
    {
        str = XmStringCreateSimple(menu_title);
        cascade = XtVaCreateManagedWidget(menu_title,
                      xmCascadeButtonGadgetClass, parent,
                      XmNsubMenuId,               menu,
                      XmNlabelString,             str,
                      XmNmnemonic,                menu_mnemonic,
                      NULL);
        XmStringFree(str);
```

```
}
else if (menu_type == XmMENU_OPTION)
{
    /* Option menus are a special case, but not hard to handle */
    Arg args[2];
    str = XmStringCreateSimple(menu_title);
    XtSetArg(args[0], XmNsubMenuId, menu);
    XtSetArg(args[1], XmNlabelString, str);

    /*
     * This really isn't a cascade, but this is the widget handle
     * we're going to return at the end of the function.
     */
    cascade = XmCreateOptionMenu(parent, menu_title, args, 2);
    XmStringFree(str);
}

/*  Now add the menu items */
for (i = 0; items[i].label != NULL; i++)
{
    /*
     *  If subitems exist, create the pull-right menu by calling
     *  this function recursively  Since the function returns a
     *  cascade button, the widget returned is used.
     */
     if (items[i].subitems)
         if (menu_type == XmMENU_OPTION)
         {
             XtWarning ("you can't have submenus from option menu items");
             continue;
         }
         else
         {
              widget = BuildMenu(menu, XmMENU_PULLDOWN, items[i].label,
                              items[i].mnemonic, items[i].subitems);
         }
     else
         widget = XtVaCreateManagedWidget(items[i].label,
                                          *items[i].class,
                                          menu, NULL);

     /*
      * Whether the item is a real item or a cascade button with a
      * menu, it can still have a mnemonic.
      */
     if (items[i].mnemonic)
         XtVaSetValues(widget, XmNmnemonic, items[i].mnemonic, NULL);

     /*
      * any item can have an accelerator, except cascade menus. But,
      * we dont warry about that; we know better in our declarations.
      */
     if (items[i].accelerator)
     {
         str = XmStringCreateSimple(items[i].accel_text);
         XtVaSetValues(widget,
                       XmNaccelerator,     items[i].accelerator,
                       XmNacceleratorText, str,
                       NULL);
         XmStringFree(str);
     }
     if(items[i].callback)
         XtAddCallback(widget,
                 (items[i].class == &xmToggleButtonWidgetClass ||
                  items[i].class == &xmToggleButtonGadgetClass)?
                      XmNvalueChangedCallback : /* ToggleButton class */
```

```
                        XmNactivateCallback,       /* PushButton class    */
                    items[i].callback, items[i].callback_data);
        }

    /*
     * For popup menus, just return the menu; pulldown menus, return
     * the cascade button; option menus, return the thing returned
     * from XmCreateOptionMenu().  THis isn't a menu, or a cascade button
     */
    return menu_type == XmMENU_POPUP? menu : cascade;
}
```

popupclearancemenu.c

```
#include <Xm/DialogS.h>
#include <Xm/PushBG.h>
#include <Xm/PushB.h>
#include <Xm/RowColumn.h>
#include "menus.h"
#include "constants.h"

extern void SetWidgetColorScheme();
extern Widget BuildMenu();
extern int buttonPressX, buttonPressY;

Widget dataSelectionDialog;

Widget popUpClearanceSelection(widgetId)
Widget widgetId;

{
    Widget dsRowCol, menuWidget;
    Dimension x, y;

    dsRowCol = XtVaCreateWidget("deRowCol",
                                xmRowColumnWidgetClass,
                                XtParent(widgetId),
                                NULL);
    XtManageChild(dsRowCol);

    menuWidget = BuildMenu(dsRowCol,
                           XmMENU_POPUP,
                           "Data",
                           NULL,
                           overheadClearanceMenu);

    SetWidgetColorScheme(menuWidget, dialogSectionTitleColor);

    XtVaSetValues(menuWidget, XmNx, buttonPressX, NULL);
    XtVaSetValues(menuWidget, XmNy, buttonPressY, NULL);
    XtManageChild(menuWidget);
    return(dsRowCol);
}
```

setwidgetcolorscheme.c

```
#include <Xm/Xm.h>

SetWidgetColorScheme(widget, aColor)


Widget widget;
char   aColor[];

{
    Colormap cmap;
    XColor color, unused;
    Pixel bg_color, top_shadow, bottom_shadow, fg, fg_ret, select_color;

    /* Get the colormap */
    XtVaGetValues(widget, XmNcolormap, &cmap, NULL);

    /* Convert the color "aColor" to a pixel value
       from the given colormap */
    XAllocNamedColor(XtDisplay(widget), cmap, aColor, &color, &unused);
    bg_color = color.pixel;

    /* Let Motif calculate the new colors base on that one color */
    XmGetColors(XtScreen(widget), cmap, bg_color, &fg_ret, &top_shadow,
                &bottom_shadow, &select_color);

    /* Set the colors accordingly */
    XtVaSetValues(widget,
                  XmNbackground,         bg_color,
                  XmNtopShadowColor,     top_shadow,
                  XmNbottomShadowColor,  bottom_shadow,
                  XmNselectColor,        select_color,
                  XmNarmColor,           select_color,
                  XmNborderColor,        fg_ret,
                  NULL);
}
```

dataentry.c

```
#include <Xm/DialogS.h>
#include <Xm/PushBG.h>
#include <Xm/PushB.h>
#include <Xm/LabelG.h>
#include <Xm/PanedW.h>
#include <Xm/Form.h>
#include <Xm/RowColumn.h>
#include <Xm/ToggleBG.h>
#include <Xm/Text.h>
#include <Xm/TextF.h>
#include <Xm/Frame.h>

#include <stdlib.h>

#include "typedefs.h"
#include "constants.h"
#include "dataentry.h"

XtCallbackProc ComputeButtonAction();
XtCallbackProc ExitDataEntry();
XtCallbackProc DataButtonAction();
XtCallbackProc ReadSeatPositionValue();
XtCallbackProc ReadMeasurementValue();
void CrewStationValue();
void AircraftSelection();
void UpdateCrewStationWidgets();

extern Widget popUpDataSelection();
extern Widget popUpClearanceSelection();

int  nbrCrewStations = 0;
extern MenuItem dataMenu;

Widget deShell, crewStationWidgets[MAX_CREW_STATIONS_PER_AIRCRAFT],
                measurementWidget[MAX_MEASUREMENTS_TAKEN],
                aircraftWidgets[MAX_AIRCRAFT],
                seatPositionWidget[MAX_SEAT_ADJ_DIRECTIONS],
                dataSelectionDialog, csToggleRowCol, csFrame;

FitData analysisData;
long   pictureId;
extern void updateXY();


void popupDataEntryWindow(widgetId, client_data, call_data)
Widget widgetId;
caddr_t client_data;
caddr_t call_data;

{
    Widget fillInForm, aGadget, fieldRowCol,
           deForm, acRowCol, csRowCol, fieldForm,
           acToggleRowCol, deRowCol, actRowCol,
           spRowCol, actionForm,  computeButton,
           buttonForm, dataButton, exitButton, actionFrame, aFrame;
    XtWidgetGeometry geom;
    char debuf[2];

    int  rowy = 12, colx = 2, yspace = 35, i = 0, j, k= 0;

    /*****************************************************************
     *                      Create dialog shell                      *
     *****************************************************************/
    deShell = XtVaCreateManagedWidget("deShell",
                xmDialogShellWidgetClass,   XtParent(widgetId),
                XmNtitle,                   "Individual Body Type Fit Analysis",
```

```
                XmNdeleteResponse,          XmDESTROY,
                XmNmaxHeight,               500,
                XmNmaxWidth,                900,
                XmNminHeight,               500,
                XmNminWidth,                900,
                XmNx,                       0,
                XmNy,                       0,
                NULL);


 deRowCol = XtVaCreateWidget("deRowCol",
                xmRowColumnWidgetClass,   deShell,
                NULL);



 deForm = XtVaCreateManagedWidget("deForm",
                xmFormWidgetClass,   deRowCol,
                XmNfractionBase,            100,
                NULL);

 SetWidgetColorScheme(deForm, dialogBGColor);

 aFrame = XtVaCreateManagedWidget("aFrame",
                xmFrameWidgetClass,         deForm,
                XmNtopAttachment,           XmATTACH_POSITION,
                XmNtopPosition,             3,
                XmNleftAttachment,          XmATTACH_POSITION,
                XmNleftPosition,            5,
                XmNrightAttachment,         XmATTACH_POSITION,
                XmNrightPosition,           95,
                NULL);

 fillInForm = XtVaCreateManagedWidget("fillInForm",
                xmFormWidgetClass,   aFrame,
                XmNfractionBase,            100,
                NULL);

 SetWidgetColorScheme(fillInForm, dialogSectionBGColor);

 aGadget = XtVaCreateManagedWidget("Individual Measurement Data:",
                xmLabelWidgetClass,         fillInForm,
                XmNtopAttachment,           XmATTACH_POSITION,
                XmNtopPosition,             0,
                XmNleftAttachment,          XmATTACH_POSITION,
                XmNleftPosition,            0,
                NULL);

 SetWidgetColorScheme(aGadget, dialogSectionTitleColor);

/************************************************************
 *      Create Individual Measurement Data entry area       *
 ************************************************************/
for (j=0; j<XtNumber(deLabels); j++)
{
     fieldForm  = XtVaCreateWidget("deRowColumn",
           xmFormWidgetClass,           fillInForm,
           XmNtopAttachment,            XmATTACH_POSITION,
           XmNtopPosition,              rowy,
           XmNleftAttachment,           XmATTACH_POSITION,
           XmNleftPosition,             colx,
           XmNrightAttachment,          XmATTACH_POSITION,
           XmNrightPosition,            colx+46,
           NULL);

     SetWidgetColorScheme(fieldForm, dialogSectionBGColor);
```

```
    XtVaCreateManagedWidget(deLabels[j],
          xmLabelGadgetClass,              fieldForm,
          XmNtopAttachment,                XmATTACH_POSITION,
          XmNtopPosition,                  1,
          XmNleftAttachment,               XmATTACH_POSITION,
          XmNleftPosition,                 1,
          NULL);

    measurementWidget[j] = XtVaCreateManagedWidget(debuf,
          xmTextFieldWidgetClass,              fieldForm,
          XmNcolumns,                      4,
          XmNmaxLength,                    4,
          XmNtopAttachment,                XmATTACH_POSITION,
          XmNtopPosition,                  1,
          XmNleftAttachment,               XmATTACH_POSITION,
          XmNleftPosition,                 70,
          NULL);

    SetWidgetColorScheme(measurementWidget[j], "wheat");

    XtAddCallback(measurementWidget[j], XmNactivateCallback,
                  ReadMeasurementValue, j);

    XtVaCreateManagedWidget("in.",
          xmLabelGadgetClass,              fieldForm,
          XmNtopAttachment,                XmATTACH_POSITION,
          XmNtopPosition,                  1,
          XmNleftAttachment,               XmATTACH_POSITION,
          XmNleftPosition,                 91,
          NULL);

    XtManageChild(fieldForm);
    if (j%2)
    {
        rowy = rowy + yspace;
        colx = 2;
    }
    else
        colx = 52;

}

/****************************************************************
 *              Create Aircraft Selection area                  *
 ****************************************************************/

aFrame = XtVaCreateManagedWidget("aFrame",
             xmFrameWidgetClass,          deForm,
             XmNtopAttachment,            XmATTACH_POSITION,
             XmNtopPosition,              50,
             XmNbottomAttachment,         XmATTACH_POSITION,
             XmNbottomPosition,           91,
             XmNleftAttachment,           XmATTACH_POSITION,
             XmNleftPosition,             5,
             XmNrightAttachment,          XmATTACH_POSITION,
             XmNrightPosition,            30,
             NULL);

acRowCol = XtVaCreateWidget("acRowCol",
             xmRowColumnWidgetClass,      aFrame,
             XmNisAligned,                True,
             XmNentryAlignment,           XmALIGNMENT_BEGINNING,
             XmNorientation,              XmVERTICAL,
             XmNnumColumns,               1,
             NULL);
```

```
SetWidgetColorScheme(acRowCol, dialogSectionBGColor);

aGadget = XtVaCreateManagedWidget("Aircraft:",
              xmLabelWidgetClass,           acRowCol,
              NULL);
SetWidgetColorScheme(aGadget, dialogSectionTitleColor);

XtManageChild(acRowCol);

acToggleRowCol = XtVaCreateWidget("acRowCol",
              xmRowColumnWidgetClass,       acRowCol,
              XmNisAligned,                 True,
              XmNentryAlignment,            XmALIGNMENT_BEGINNING,
              XmNorientation,               XmVERTICAL,
              XmNnumColumns,                1,
              XmNradioAlwaysOne,            True,
              XmNradioBehavior,             True,
              NULL);

SetWidgetColorScheme(acToggleRowCol, dialogSectionBGColor);

for (i=0; i<XtNumber(aircraft); i++)
{
    aircraftWidgets[i] = XtVaCreateManagedWidget(aircraft[i].name,
                         xmToggleButtonGadgetClass,  acToggleRowCol,
                         NULL);

    XtAddCallback(aircraftWidgets[i], XmNvalueChangedCallback,
                  AircraftSelection, i);
}

XtManageChild(acToggleRowCol);


/*****************************************************************
 *              Create Crewstation Selection area                *
 *****************************************************************/
csFrame = XtVaCreateManagedWidget("aFrame",
              xmFrameWidgetClass,           deForm,
              XmNtopAttachment,             XmATTACH_POSITION,
              XmNtopPosition,               50,
              XmNbottomAttachment,          XmATTACH_POSITION,
              XmNbottomPosition,            91,
              XmNleftAttachment,            XmATTACH_POSITION,
              XmNleftPosition,              35,
              XmNrightAttachment,           XmATTACH_POSITION,
              XmNrightPosition,             55,
              NULL);


csRowCol = XtVaCreateWidget("csRowCol",
              xmRowColumnWidgetClass,       csFrame,
              XmNorientation,               XmVERTICAL,
              XmNnumColumns,                1,
              NULL);
SetWidgetColorScheme(csRowCol, dialogSectionBGColor);

aGadget = XtVaCreateManagedWidget("Crewstation:",
              xmLabelWidgetClass,           csRowCol,
              NULL);
SetWidgetColorScheme(aGadget, dialogSectionTitleColor);

csToggleRowCol = XtVaCreateWidget("csRowCol",
              xmRowColumnWidgetClass,       csRowCol,
              XmNorientation,               XmVERTICAL,
              XmNnumColumns,                1,
```

```
               XmNradioAlwaysOne,            True,
               XmNradioBehavior,             True,
               NULL);
SetWidgetColorScheme(csToggleRowCol, dialogSectionBGColor);

XtManageChild(csRowCol);


/***********************************************************
 *               Create Seat Position data area            *
 ***********************************************************/
aFrame = XtVaCreateManagedWidget("aFrame",
               xmFrameWidgetClass,           deForm,
               XmNtopAttachment,             XmATTACH_POSITION,
               XmNtopPosition,               50,
               XmNleftAttachment,            XmATTACH_POSITION,
               XmNleftPosition,              60,
               XmNrightAttachment,           XmATTACH_POSITION,
               XmNrightPosition,             95,
               NULL);

spRowCol = XtVaCreateWidget("spRowCol",
               xmRowColumnWidgetClass,       aFrame,
               XmNorientation,               XmVERTICAL,
               XmNnumColumns,                1,
               NULL);

SetWidgetColorScheme(spRowCol, dialogSectionBGColor);


aGadget = XtVaCreateManagedWidget("Seat Position:",
               xmLabelWidgetClass,           spRowCol,
               XmNtopAttachment,             XmATTACH_POSITION,
               XmNtopPosition,               1,
               XmNleftAttachment,            XmATTACH_POSITION,
               XmNleftPosition,              1,
               NULL);

SetWidgetColorScheme(aGadget, dialogSectionTitleColor);

rowy = 25;
for (j=0; j<XtNumber(seatPositions); j++)
{
    fieldForm  = XtVaCreateWidget("deRowColumn",
          xmFormWidgetClass,            spRowCol,
          NULL);

    SetWidgetColorScheme(fieldForm, dialogSectionBGColor);

    XtVaCreateManagedWidget(seatPositions[j],
          xmLabelGadgetClass,           fieldForm,
          XmNtopAttachment,             XmATTACH_POSITION,
          XmNtopPosition,               1,
          XmNleftAttachment,            XmATTACH_POSITION,
          XmNleftPosition,              1,

          NULL);

    seatPositionWidget[j] = XtVaCreateManagedWidget(debuf,
          xmTextFieldWidgetClass,       fieldForm,
          XmNcolumns,                   4,
          XmNmaxLength,                 4,
          XmNtopAttachment,             XmATTACH_POSITION,
          XmNtopPosition,               1,
          XmNleftAttachment,            XmATTACH_POSITION,
          XmNleftPosition,              77,
```

```
            NULL);

        XtAddCallback(seatPositionWidget[j], XmNactivateCallback,
                      ReadSeatPositionValue, j);

        SetWidgetColorScheme(seatPositionWidget[j], dialogFillInFieldColor);

        XtManageChild(fieldForm);

        rowy = rowy + yspace+5;

    }

    fieldForm  = XtVaCreateWidget("deRowColumn",
            xmFormWidgetClass,          spRowCol,
            NULL);

    SetWidgetColorScheme(fieldForm, dialogSectionBGColor);
    computeButton = XtVaCreateManagedWidget("ComputeButton",
                xmPushButtonWidgetClass, fieldForm,
                XmNlabelString,          XmStringCreateSimple("Compute"),
                XmNtopAttachment,           XmATTACH_POSITION,
                XmNtopPosition,             1,
                XmNleftAttachment,          XmATTACH_POSITION,
                XmNleftPosition,            35,
                NULL);

    SetWidgetColorScheme(computeButton, dialogSectionTitleColor);
    XtAddEventHandler(computeButton, ButtonPressMask, FALSE, updateXY, NULL);
    XtAddCallback(computeButton, XmNactivateCallback, ComputeButtonAction, NULL);

    XtManageChild(fieldForm);
    XtManageChild(spRowCol);

    /*************************************************************
     *    Create the action button area at the bottom of the      *
     *    window, and put in a Data and an Exit button.           *
     *************************************************************/
    actionForm = XtVaCreateWidget("dataButtonRowCol",
                  xmFormWidgetClass,      deForm,
                  XmNtopAttachment,           XmATTACH_POSITION,
                  XmNtopPosition,             92,
                 XmNbottomAttachment,        XmATTACH_POSITION,
                 XmNbottomPosition,          99,
                  XmNleftAttachment,          XmATTACH_POSITION,
                  XmNleftPosition,            30,
                  XmNrightAttachment,         XmATTACH_POSITION,
                  XmNrightPosition,           70,
                  NULL);

    SetWidgetColorScheme(actionForm, dialogBGColor);
    XtManageChild(actionForm);

    actRowCol = XtVaCreateWidget("actRowCol",
                 xmRowColumnWidgetClass,     actionForm,
                 XmNtopAttachment,           XmATTACH_POSITION,
                 XmNtopPosition,             1,
                 XmNleftAttachment,           XmATTACH_POSITION,
                 XmNleftPosition,             1,
                 XmNrightAttachment,           XmATTACH_POSITION,
                 XmNrightPosition,             100,
                 XmNorientation,             XmHORIZONTAL,
                 XmNnumColumns,              2,
                 XmNspacing,                 200,
                 NULL);
    XtManageChild(actRowCol);
```

```
    SetWidgetColorScheme(actRowCol, dialogBGColor);

    dataButton = XtVaCreateManagedWidget("DataButton",
                 xmPushButtonWidgetClass, actRowCol,
                 XmNlabelString,          XmStringCreateSimple("Data"),
                 NULL);
    SetWidgetColorScheme(dataButton, dialogSectionTitleColor);
    XtAddCallback(dataButton, XmNactivateCallback, DataButtonAction, NULL);

    XtAddEventHandler(dataButton, ButtonPressMask, FALSE, updateXY, NULL);
    exitButton = XtVaCreateManagedWidget("ExitButton",
                 xmPushButtonWidgetClass, actRowCol,
                 XmNlabelString,          XmStringCreateSimple("Exit"),
                 NULL);
    SetWidgetColorScheme(exitButton, dialogSectionTitleColor);
    XtAddCallback(exitButton, XmNactivateCallback, ExitDataEntry, NULL);

    XtManageChild(deRowCol);
}


XtCallbackProc ComputeButtonAction(widget_id, client_data, call_data)

Widget widget_id;
caddr_t client_data;
caddr_t call_data;

{

   if (dataSelectionDialog != NULL)
        XtUnmanageChild(dataSelectionDialog);

   popUpClearanceSelection(widget_id);
}

/********************************************************
 *   The Data button was clicked, so pop up the data        *
 *   selection dialog for selecting the type of data to     *
 *   receive a report for.                                  *
 ********************************************************/
XtCallbackProc DataButtonAction(widget_id, client_data, call_data)

Widget widget_id;
caddr_t client_data;
caddr_t call_data;

{

   if (dataSelectionDialog != NULL)
        XtUnmanageChild(dataSelectionDialog);

   dataSelectionDialog = popUpDataSelection(widget_id);
}

/********************************************************
 *    Display the crew stations for the selected aircraft   *
 ********************************************************/
void RedisplayCrewStations()

{
    int i = 0;

    while (crewStations[i].idCode)
    {
        crewStationWidgets[i] = XtVaCreateManagedWidget(crewStations[i].name,
                  xmToggleButtonGadgetClass,  csToggleRowCol,
```

```
                    NULL);

         XtAddCallback(crewStationWidgets[i], XmNvalueChangedCallback,
                       CrewStationValue, i);
         i++;
     }
     XtManageChild(csToggleRowCol);
}


/*************************************************************
 *    Update Crewstation selection on the data entry screen *
 *    to reflect those crewstations found on the aircraft   *
 *    that has been selected                                *
 *************************************************************/
void UpdateCrewStationWidgets(selectedAircraftIdCode)

int  selectedAircraftIdCode;

{
    int i;

    int index = 0;

    /********  Query Database here for Aircraft Profile  *******/

    for (i=0; i<nbrCrewStations; i++)
    {
        XtUnmanageChild(crewStationWidgets[i]);
    }
    XtUnmanageChild(csToggleRowCol);

    /*************************************************************
     *  Reset the available crewStations array in preparation   *
     *  to reflect the crew stations available for the selected *
     *  aircraft.                                               *
     *************************************************************/
    nbrCrewStations = 0;
    for (i=0; i<MAX_CREW_STATIONS_PER_AIRCRAFT; i++)
    {
        strcpy(crewStations[i].name, " ");
        crewStations[i].idCode = 0;
    }


    /*********  Fill in updated crewstation info from Database *******/


    switch(selectedAircraftIdCode+1)
    {
        case F_16_A :
            strcpy(crewStations[0].name,"Forward");
            crewStations[0].idCode = CREW_FORWARD;
            nbrCrewStations = 1;
            break;

        case C_141_A :
            strcpy(crewStations[0].name,"Left");
            crewStations[0].idCode = CREW_LEFT;
            strcpy(crewStations[1].name,"Right");
            crewStations[1].idCode = CREW_RIGHT;
            nbrCrewStations = 2;
            break;
```

```
        case T_37_B :
            strcpy(crewStations[0].name,"Left");
            crewStations[0].idCode = CREW_LEFT;
            strcpy(crewStations[1].name,"Right");
            crewStations[1].idCode = CREW_RIGHT;
            nbrCrewStations = 2;
            break;

        case T_38_A :
            strcpy(crewStations[0].name,"Forward");
            crewStations[0].idCode = CREW_FORWARD;
            strcpy(crewStations[1].name,"Aft");
            crewStations[1].idCode = CREW_AFT;
            nbrCrewStations = 2;
            break;

        case T_1_A :
            strcpy(crewStations[0].name,"Left");
            crewStations[0].idCode = CREW_LEFT;
            strcpy(crewStations[1].name,"Right");
            crewStations[1].idCode = CREW_RIGHT;
            nbrCrewStations = 2;
            break;

        default:
            break;
    };

    RedisplayCrewStations();
}


void AircraftSelection(widget_id, which, state)
Widget widget_id;
int which;
XmToggleButtonCallbackStruct *state;

{
    if (state->set)
    {

        /*****************************************************
         *  Update crewstation selection widget on data      *
         *  entry screen.                                     *
         *****************************************************/
        UpdateCrewStationWidgets(which);

    }
}


void CrewStationValue(widget_id, which, state)

Widget widget_id;
int which;
XmToggleButtonCallbackStruct *state;

{
    if (state->set)
       analysisData.selectedCrewStations[1] = crewStations[which].idCode;
}
```

```
XtCallbackProc ReadSeatPositionValue(widget_id, client_data, call_data)

Widget widget_id;
int client_data;
int call_data;

{
    float  fieldValue;

    fieldValue = (float) atof(XmTextFieldGetString(widget_id));
    switch (client_data)
    {
       case 0 :
           analysisData.vertSeatPosition = fieldValue;
           break;
       case 1 :
           analysisData.horzSeatPosition = fieldValue;
           break;
    }
}


XtCallbackProc ReadMeasurementValue(widget_id, client_data, call_data)

Widget widget_id;
int client_data;
int call_data;

{
    float  fieldValue;

    fieldValue = (float) atof(XmTextFieldGetString(widget_id));
    switch (client_data)
    {
       case 0 :
           analysisData.thumbTipReach = fieldValue;
           break;
       case 1 :
           analysisData.buttockKneeLength = fieldValue;
           break;
       case 2 :
           analysisData.shoulderHeight = fieldValue;
           break;
       case 3 :
           analysisData.sittingHeight = fieldValue;
           break;
       case 4 :
           analysisData.kneeHeightSitting = fieldValue;
           break;
       case 5 :
           analysisData.eyeHeightSitting = fieldValue;
           break;
    }
}

void updateAnalysisData()
{
    int j;

    for (j=0; j<XtNumber(deLabels); j++)
    {
       ReadMeasurementValue(measurementWidget[j], j, NULL);
    }
```

```
    for (j=0; j<XtNumber(seatPositions); j++)
    {
        ReadSeatPositionValue(seatPositionWidget[j], j, NULL);
    }
}


void printAnalysisData()
{

    printf("Thumb Tip Reach:      %3.1f\n",analysisData.thumbTipReach);
    printf("Buttock-Knee Length: %3.1f\n",analysisData.buttockKneeLength);
    printf("Shoulder Height:      %3.1f\n",analysisData.shoulderHeight);
    printf("Sitting Height:       %3.1f\n",analysisData.sittingHeight);
    printf("Knee Height Sitting: %3.1f\n",analysisData.kneeHeightSitting);
    printf("Eye Height Sitting:  %3.1f\n",analysisData.eyeHeightSitting);
    printf("Vertical Position:   %3.1f\n",analysisData.vertSeatPosition);
    printf("Horizontal Position: %3.1f\n",analysisData.horzSeatPosition);
    printf("selectedAircraft:     %d\n",analysisData.selectedAircraft[1]);
    printf("selectedCrewStations:%d\n",analysisData.selectedCrewStations[1]);
    printf("clearanceOverhead:%d\n",analysisData.clearanceOverhead);
}

XtCallbackProc ExitDataEntry(widget_id, client_data, call_data)

Widget widget_id;
caddr_t client_data;
caddr_t call_data;

{
   updateAnalysisData();
   printAnalysisData();
   XtDestroyWidget(deShell);
}
```

popupdataselection.c

```
#include <Xm/DialogS.h>
#include <Xm/PushBG.h>
#include <Xm/PushB.h>
#include <Xm/RowColumn.h>
#include "menus.h"
#include "constants.h"

extern void SetWidgetColorScheme();
extern Widget BuildMenu();
extern int buttonPressX, buttonPressY;

Widget dataSelectionDialog;

Widget popUpDataSelection(widgetId)
Widget widgetId;

{
    Widget dsRowCol, menuWidget;
    Dimension x, y;

    dsRowCol = XtVaCreateWidget("deRowCol",
                                xmRowColumnWidgetClass,
                                XtParent(widgetId),
                                NULL);
    XtManageChild(dsRowCol);

    menuWidget = BuildMenu(dsRowCol,
                           XmMENU_POPUP,
                           "Data",
                           NULL,
                           dataMenu);

    printf("x = %d\n",buttonPressX);
    printf("y = %d\n",buttonPressY);

    SetWidgetColorScheme(menuWidget, dialogSectionTitleColor);

    XtVaSetValues(menuWidget, XmNx, buttonPressX, NULL);
    XtVaSetValues(menuWidget, XmNy, buttonPressY, NULL);
    XtManageChild(menuWidget);
    return(dsRowCol);
}
```

displaypicture.c

```
/*
 *      showimg -
 *              Display a color or black and white image on the iris.  Simple
 *      version for demo use.  This will only work on machines that support
 *      RGB mode.
 *                                  Paul Haeberli - 1988
 */
#include <stdio.h>
#include <gl.h>
#include <device.h>
#include <image.h>

unsigned short rs[8192];
unsigned short gs[8192];
unsigned short bs[8192];

unsigned char rb[8192];
unsigned char gb[8192];
unsigned char bb[8192];

short colorbuff[4096];
IMAGE *image;
int x, y, xsize, ysize, zsize;
int xscreensize;
int yscreensize;
short val;
extern long pictureId;

void DisplayPicture(filename, title)
char *filename;
char *title;
{

    if (pictureId)
        winclose(pictureId);

    xscreensize = getgdesc(GD_XPMAX);
    yscreensize = getgdesc(GD_YPMAX);
    if( (image=iopen(filename,"r")) == NULL )
    {
        printf("displayPicture: cant open input file");
        exit(1);
    }
    xsize = image->xsize;
    ysize = image->ysize;
    zsize = image->zsize;

    prefsize(xsize, ysize);

    pictureId = winopen(title);
    winmove(0,0);
    RGBmode();
    gconfig();
    drawit();
}

drawit()
{
    ortho2(-0.5,(float)xsize-0.5,-0.5,(float)ysize-0.5);
    for(y=0; y<ysize; y++) {
        if(zsize<3) {
            getrow(image,rs,y,0);
            compress(rs,rb,xsize);
            cmov2i(0,y);
            writeRGB(xsize,rb,rb,rb);
        } else {
```

```
            getrow(image,rs,y,0);
            compress(rs,rb,xsize);
            getrow(image,gs,y,1);
            compress(gs,gb,xsize);
            getrow(image,bs,y,2);
            compress(bs,bb,xsize);
            cmov2i(0,y);
            writeRGB(xsize,rb,gb,bb);
        }
    }
}

compress(sptr,bptr,n)
register unsigned short *sptr;
register unsigned char *bptr;
short n;
{
    while(n--)
        *bptr++ = *sptr++;
}
```

displaytechinfo.c

```c
#include <stdio.h>
#include <Xm/PanedW.h>
#include <string.h>
#include "constants.h"



void DisplayTechInfo(widget_id, infoFileId)

Widget widget_id;
int   infoFileId;

{
   caddr_t client_data;
   caddr_t call_data;
   char infoFilename[32];
   char *fileData;
   FILE *inputFile;
   long bufptr;



   switch (infoFileId)
   {
       case VISION :
            strcpy(infoFilename, "textdesc/vision.txt");
            break;

       case REACH_RUDDER_THROW :
            strcpy(infoFilename, "textdesc/reach_rt.txt");
            break;

       case REACH_ARM_REACH_INDIVIDUAL_CONTROLS :
            strcpy(infoFilename, "textdesc/reach_aric.txt");
            break;

       case REACH_ARM_REACH_ALL_MISSED_CONTROLS :
            strcpy(infoFilename, "textdesc/reach_aramc.txt");
            break;

       case REACH_ARM_REACH_CONTROL_REGION_LEFT_SIDE_PANEL :
            strcpy(infoFilename, "textdesc/reach_arcrlsp.txt");
            break;

       case REACH_ARM_REACH_CONTROL_REGION_LEFT_AUXILIARY_PANEL :
            strcpy(infoFilename, "textdesc/reach_arcrlap.txt");
            break;

       case REACH_ARM_REACH_CONTROL_REGION_MAIN_INSTRUMENT_PANEL :
            strcpy(infoFilename, "textdesc/reach_arcrmip.txt");
            break;

       case REACH_ARM_REACH_CONTROL_REGION_CENTER_PEDESTAL :
            strcpy(infoFilename, "textdesc/reach_arcrcp.txt");
            break;

       case REACH_ARM_REACH_CONTROL_REGION_RIGHT_SIDE_PANEL :
            strcpy(infoFilename, "textdesc/reach_arcrrsp.txt");
            break;

       case REACH_ARM_REACH_CONTROL_REGION_RIGHT_AUXILIARY_PANEL :
            strcpy(infoFilename, "textdesc/reach_arcrrap.txt");
            break;

       case CLEARANCE_OVERHEAD :
            strcpy(infoFilename, "textdesc/clearance_oh.txt");
```

```
        break;

    case CLEARANCE_SHIN_WITH_INSTRUMENT_PANEL :
        strcpy(infoFilename, "textdesc/clearance_swip.txt");
        break;

    case CLEARANCE_EJECTION_WITH_GLARE_SHIELD :
        strcpy(infoFilename, "textdesc/clearance_ewgs.txt");
        break;

    case CLEARANCE_EJECTION_WITH_CANOPY_BOW :
        strcpy(infoFilename, "textdesc/clearance_ewcb.txt");
        break;

    default:
        strcpy(infoFilename, "textdesc/invalid.txt");
        break;
}

printf("DisplayTechInfo filename: %s\n",infoFilename);

bufptr = ReadTextFile(infoFilename);

popupInfoWindow(widget_id, client_data, call_data, "Explanation",
                  bufptr);


free(bufptr);
```

generatereport.c

```
#include <stdio.h>
#include <Xm/PanedW.h>

void GenerateReport(widget_id, reportId)

Widget widget_id;
int reportId;

{

   printf("Generate report\n");
   printf("reportId: %d\n",reportId);
}
```

infowindow.c

```
/*
 *   infowindow.c
 */
#include <stdio.h>
#include <Xm/BulletinB.h>
#include <Xm/PanedW.h>
#include <Xm/PushB.h>
#include <Xm/Frame.h>
#include <Xm/Form.h>
#include <Xm/ScrolledW.h>
#include <Xm/Text.h>
#include <Xm/DrawingA.h>
#include <Xm/MessageB.h>
#include <Xm/RowColumn.h>
#include <Xm/DialogS.h>
#include <Xm/PushBG.h>
#include <gl.h>

#include "constants.h"

int  INFOX = (XMAXSCREEN / 2);
int  INFOY = YMAXSCREEN - (int) (YMAXSCREEN/4);

extern long pictureId;
extern Widget GetTopShell();
extern void DestroyShell();


popupInfoWindow(widget_id, client_data, call_data, title,
                textToDisplay)

    Widget widget_id;
    caddr_t client_data;
    caddr_t call_data;
    char title[], textToDisplay[];

{
    Widget  w, infoDialog, text_w, pane, form, widget, verticalScrollBar, label;
    Arg args[9];
    XmString xmString;
    extern void activate();
    extern void DestroyShell();
    /*
     *  Set up a DialogShell as a popup window.   Set the delete
     *  window protocol response to XmDESTROY to make sure that
     *  the window goes away appropriately.  Otherwise, it's
     *  XmUNMAP which means it'd be lost forever, since we're not
     *  storing the widget globally or statically to this function.
     */
    infoDialog = XtVaCreatePopupShell(title,
                                      xmDialogShellWidgetClass,
                                      GetTopShell(widget_id),
                                      XmNdeleteResponse,
                                      XmDESTROY,
                                      XmNx, INFOX,
                                      XmNy, INFOY,
                                      NULL);

    SetWidgetColorScheme(infoDialog, dialogBGColor);

    /*
     *  Create a RowColumn to manage the stuff in this dialog
     */
    pane = XtVaCreateWidget("pane",
                            xmRowColumnWidgetClass,
                            infoDialog
```

```
                              NULL);
    SetWidgetColorScheme(pane, dialogBGColor);

    /*
     *  Create a RowColumn in the form for Label and Text widgets
     */
    form = XtVaCreateWidget("form",
                              xmFormWidgetClass,
                              pane,
                              NULL);

    SetWidgetColorScheme(form, dialogFillInFieldColor);
    /*
     *  Convert the textual content to be displayed
     *  into an instance of ScrolledText
     */
    XtSetArg(args[0], XmNscrollVertical, TRUE);
    XtSetArg(args[1], XmNscrollHorizontal, FALSE);
    XtSetArg(args[2], XmNeditMode, FALSE);
    XtSetArg(args[3], XmNeditable, FALSE);
    XtSetArg(args[4], XmNcursorPositionVisible, FALSE);
    XtSetArg(args[5], XmNwordWrap, TRUE);
    XtSetArg(args[6], XmNvalue, textToDisplay);
    XtSetArg(args[7], XmNheight, (int)(YMAXSCREEN/4));
    XtSetArg(args[8], XmNwidth, (int)(XMAXSCREEN/2));
    text_w = XmCreateScrolledText(form,
                                   "help_text",
                                   args,
                                   9);

/*    XtGetValues(text_w, XmNverticalScrollBar, &verticalScrollBar, NULL);
    SetWidgetColorScheme(verticalScrollBar, dialogFillInFieldColor);
*/
    SetWidgetColorScheme(text_w, dialogFillInFieldColor);

    XtManageChild(text_w);
    XtManageChild(form);

    /*
     *  Create another form to use as an action area for the dialog
     */
    form = XtVaCreateWidget("form2", xmFormWidgetClass,
                              pane, XmNfractionBase, 5, NULL);
    SetWidgetColorScheme(form, dialogBGColor);

    /*
     * Create the OK button
     */
    widget = XtVaCreateManagedWidget("Ok",
                                      xmPushButtonWidgetClass, form,
                                      XmNtopAttachment, XmATTACH_FORM,
                                      XmNbottomAttachment, XmATTACH_FORM,
                                      XmNleftAttachment, XmATTACH_POSITION,
                                      XmNleftPosition, 2,
                                      XmNrightAttachment, XmATTACH_POSITION,
                                      XmNrightPosition, 3,
                                      NULL);
    SetWidgetColorScheme(widget, dialogSectionTitleColor);

    /*
     *  Add callback routine for the OK button
     */
    XtAddCallback(widget, XmNactivateCallback,
                  DestroyShell, infoDialog);
```

```
    XtManageChild(form);
    {
       Dimension h;
       XtVaGetValues(widget, XmNheight, &h, NULL);
       XtVaSetValues(form, XmNpaneMaximum, h, XmNpaneMinimum, h, NULL);
    }

    XtManageChild(pane);

    XtPopup(infoDialog, XtGrabNone);
}
```

readtextfile.c

```
#include <stdio.h>
#include <stdlib.h>
#include <sys/stat.h>
#include <malloc.h>

/*
void main()
{
    char  *dataptr,*buffer;
    long   bufsize, i;
    long   bufptr;

    bufptr = ReadTextFile("textdesc/c141_desc");
    printf("%s",bufptr);
}
*/

/*****************************************************************
 *  This routine opens the file named "filename", allocates     *
 *  enough memory to hold the file's contents, and reads the    *
 *  file into that buffer, returning a pointer to the beginning*
 *  of the data just read in.                                   *
 *****************************************************************/
long ReadTextFile(filename)


char filename[];

{
    struct stat statb;
    char *buffer;
    long bufptr, len;
    FILE *fp;

    fp = fopen(filename, "r");
    if (fp == NULL)
    {
        printf("unable to open file named: %s\n", filename);
        exit(0);
    }

    stat(filename, &statb);

    len = statb.st_size;
    if (!(buffer = malloc(len)))
        printf("ReadTextFile:  Unable to allocate memory for file contents\n");
    else
    {
        bufptr = (long)buffer;
        fread(buffer, 1, len, fp);
        fclose(fp);
        buffer+= NULL;
    }
    return (bufptr);
}
```

reportwindow.c

```
/*
 *   reportwindow.c
 */
#include <stdio.h>
#include <Xm/BulletinB.h>
#include <Xm/PanedW.h>
#include <Xm/PushB.h>
#include <Xm/Frame.h>
#include <Xm/Form.h>
#include <Xm/ScrolledW.h>
#include <Xm/Text.h>
#include <Xm/DrawingA.h>
#include <Xm/MessageB.h>
#include <Xm/RowColumn.h>
#include <Xm/DialogS.h>
#include <Xm/PushBG.h>

#include "constants.h"

popupReportWindow(widget_id, client_data, call_data, title,
                    textToDisplay)

    Widget widget_id;
    caddr_t client_data;
    caddr_t call_data;
    char title[], textToDisplay[];

{
    Widget  w, reportDialog, text_w, rowCol, form, widget, label;
    Arg args[15];
    XmString xmString;
    extern void DestroyDialog();
    extern void PrintReport();


    /*
     *  Set up a DialogShell as a popup window.  Set the delete
     *  window protocol response to XmDESTROY to make sure that
     *  the window goes away appropriately.  Otherwise, it's
     *  XmUNMAP which means it'd be lost forever, since we're not
     *  storing the widget globally or statically to this function.
     */
    reportDialog = XtVaCreatePopupShell(title,
                                        xmDialogShellWidgetClass,
                                        GetTopShell(widget_id),
                                        XmNdeleteResponse,
                                        XmDESTROY,
                                        NULL);

    /*
     *  Create a PanedWindow to manage the stuff in this dialog
     */
    rowCol = XtVaCreateWidget("rowCol",
                              xmRowColumnWidgetClass,
                              reportDialog,
                              XmNorientation, XmVERTICAL,
                              XmNcolumns,     1,
                              NULL);

    /*
     *  Create a RowColumn in the form for Label and Text widgets
     */
    form = XtVaCreateWidget("form",
                            xmFormWidgetClass,
                            rowCol,
                            XmNfractionBase, 100,
```

```
                          NULL);
SetWidgetColorScheme(form, dialogBGColor);

/*
 *  Convert the textual content to be displayed
 *  into an instance of ScrolledText
 */
XtSetArg(args[0], XmNscrollVertical, TRUE);
XtSetArg(args[1], XmNscrollHorizontal, FALSE);
XtSetArg(args[2], XmNeditMode, FALSE);
XtSetArg(args[3], XmNeditable, FALSE);
XtSetArg(args[4], XmNcursorPositionVisible, FALSE);
XtSetArg(args[5], XmNwordWrap, TRUE);
XtSetArg(args[6], XmNvalue, textToDisplay);
XtSetArg(args[7], XmNrows, 10);
XtSetArg(args[8], XmNcolumns, 60);
XtSetArg(args[9], XmNtopAttachment, XmATTACH_FORM);
XtSetArg(args[10], XmNbottomAttachment, XmATTACH_POSITION);
XtSetArg(args[11], XmNbottomPosition, 80);
XtSetArg(args[12], XmNleftAttachment, XmATTACH_FORM);
XtSetArg(args[13], XmNrightAttachment, XmATTACH_FORM);

text_w = XmCreateScrolledText(form,
               "text_w",
               args,
               14);

XtManageChild(text_w);


/*
 * Create the Print button
 */
widget = XtVaCreateManagedWidget("Print",
                xmPushButtonGadgetClass, form,
                XmNtopAttachment,        XmATTACH_POSITION,
                XmNtopPosition,          85,
                XmNbottomAttachment,     XmATTACH_FORM,
                XmNleftAttachment,       XmATTACH_POSITION,
                XmNleftPosition,         25,
                XmNrightAttachment,      XmATTACH_POSITION,
                XmNrightPosition,        35,
                XmNshowAsDefault,        TRUE,
                XmNdefaultButtonShadowThickness, 2,
                NULL);

/*
 *  Add callback routine for the Print button
 */
XtAddCallback(widget, XmNactivateCallback,
              PrintReport, reportDialog);


/*
 * Create the Cancel button
 */
widget = XtVaCreateManagedWidget("Cancel",
                xmPushButtonGadgetClass, form,
                XmNtopAttachment,        XmATTACH_POSITION,
                XmNtopPosition,          85,
                XmNbottomAttachment,     XmATTACH_FORM,
                XmNleftAttachment,       XmATTACH_POSITION,
                XmNleftPosition,         65,
                XmNrightAttachment,      XmATTACH_POSITION,
                XmNrightPosition,        75,
                XmNshowAsDefault,        TRUE,
```

```
                    XmNdefaultButtonShadowThickness, 2,
                    NULL);

    /*
     *  Add callback routine for the Print button
     */
    XtAddCallback(widget, XmNactivateCallback,
                  DestroyDialog, reportDialog);


   XtManageChild(form);
   XtManageChild(rowCol);

   XtPopup(reportDialog, XtGrabNone);
}



void PrintReport(widget, shell)
Widget widget, shell;
{
   system("lp reportwindow.c");
}
```

updateclearanceselection.c

```
#include <Xm/Xm.h>
#include "typedefs.h"


extern FitData analysisData;

void updateClearanceSelection(widget_id, clearanceSelection)

Widget widget_id;
int     clearanceSelection;

{
   analysisData.clearanceOverhead = clearanceSelection;
}
```

utils.c

```
#include <Xm/Xm.h>

/*************************************************************
 *   Utility routines used throughout the program            *
 *************************************************************/

extern long pictureId;

/*************************************************************
 *  Routine called as a callback to destroy the widget       *
 *  contained in the argument "shell"                        *
 *************************************************************/
void DestroyDialog(widget, shell)
Widget widget, shell;
{
   XtDestroyWidget(shell);
}


/*************************************************************
 *  Routine to find the top level shell of a widget          *
 *************************************************************/
Widget GetTopShell(w)
Widget w;
{
    while (w && !XtIsWMShell(w))
       w = XtParent(w);
    return w;
}


/*************************************************************
 *  Routine called as a callback to destroy the widget       *
 *  contained in the argument "shell", as well as an         *
 *  associated picture, if the picture is displayed (Id > 0)*
 *************************************************************/
void DestroyShell(widget, shell)
Widget widget, shell;
{

   /* If a picture is being displayed, then close it's window */
   if (pictureId)
       winclose(pictureId);

   XtDestroyWidget(shell);
```

dataentry.h

```
/***************************************************************
 *    Field labels used in data entry window                  *
 ***************************************************************/
char *deLabels[] = { "Thumb Tip Reach:\n(Reach)",
                     "Buttock-Knee Length:\n(Rudder Throw, Shin,\nand Leg Clearance
                     "Shoulder Height:\n(Reach)",
                     "Sitting Height:\n(Overhead Clearance)",
                     "Knee Height Sitting:\n(Rudder Throw)",
                     "Eye Height Sitting:\n(Vision)" };

/***************************************************************
 *                 Crew Station Definitions                    *
 *  Updated during Aircraft Selection after Database query.   *
 ***************************************************************/
CrewStations crewStations[MAX_CREW_STATIONS_PER_AIRCRAFT] =
{ {" ",              0},
  {" ",              0},
  {" ",              0},
  {" ",              0},
  {" ",              0},
  {" ",              0},
  {" ",              0},
  {" ",              0},
  {" ",              0},
  {" ",              0},
  {" ",              0},
  {" ",              0},
  {" ",              0},
  {" ",              0},
  {" ",              0},
  {" ",              0},
  {" ",              0},
  {" ",              0},
  {" ",              0},
  {" ",              0} };

char *seatPositions[] = {"Vert. Position:",
                         "Horz. Position: "};

/***************************************************************
 *  Specific attributes for each aircraft. (Room for expansion) *
 ***************************************************************/
AvailableAircraft aircraft[] =
{{  "F-16A",                      /*  Aircraft Name  */
    F_16_A,                       /*  Aircraft ID Code */
    CREW_FORWARD,                 /*  Possible crewstations for this aircraft */
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
```

```
    VERTICAL,                        /*  Possible seat directions
    0,                               /*  Number of adjustment notches travel from ze
    HORIZONTAL,
    0 },

{   "C-141A",                        /*  Aircraft Name  */
    C_141_A,                         /*  Aircraft ID Code */
    CREW_LEFT,                       /*  Possible crewstations for this aircraft */
    CREW_RIGHT,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    VERTICAL,                        /*  Possible seat directions
    0,                               /*  Number of adjustment notches travel from ze
    HORIZONTAL,
    0 },

{   "T-37B",                         /*  Aircraft Name  */
    T_37_B,                          /*  Aircraft ID Code */
    CREW_LEFT,                       /*  Possible crewstations for this aircraft */
    CREW_RIGHT,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    VERTICAL,                        /*  Possible seat directions
    0,                               /*  Number of adjustment notches travel from ze
    HORIZONTAL,
    0 },

{   "T-38A",                         /*  Aircraft Name  */
    T_38_A,                          /*  Aircraft ID Code */
    CREW_FORWARD,                    /*  Possible crewstations for this aircraft */
    CREW_AFT, .
    0,
    0,
```

```
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    VERTICAL,                        /*  Possible seat directions
    0,                               /*  Number of adjustment notches travel from ze
    HORIZONTAL,
    0 },

{   "T-1A",                         /*  Aircraft Name  */
    T_1_A,                          /*  Aircraft ID Code */
    CREW_RIGHT,                     /*  Possible crewstations for this aircraft */
    CREW_LEFT,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    0,
    VERTICAL,                        /*  Possible seat directions
    0,                               /*  Number of adjustment notches travel from ze
    HORIZONTAL,
    0 } };
```

menu.h

```
#include "typedefs.h"

extern void F16ASurveyDesc();
extern void C141ASurveyDesc();
extern void T37BSurveyDesc();
extern void T38ASurveyDesc();
extern void T1ASurveyDesc();
extern void GenerateReport();
extern void DisplayTechInfo();
extern void updateClearanceSelection();

MenuItem aircraftMenu[] =
{
  { "F-16A",                      /* Item Label                         */
    &xmPushButtonGadgetClass,     /* PushButton                         */
    NULL,                         /* mnemonic or NULL                   */
    NULL,                         /* Accelerator or NULL                */
    NULL,                         /* to be converted to compound str */
    F16ASurveyDesc,               /* Routine to call                    */
    0,                            /* Client_data for callback()         */
    NULL },                       /* Pullright menu items               */
  { "C-141A",
    &xmPushButtonGadgetClass,
    NULL,
   NULL,
    NULL,
    C141ASurveyDesc,
    0,
    NULL },
  { "T-37B",
    &xmPushButtonGadgetClass,
    NULL, NULL,
              NULL,
    T37BSurveyDesc,
    0,
    NULL },
  { "T-38A",
    &xmPushButtonGadgetClass,
    NULL,
    NULL,
    NULL,
    T38ASurveyDesc,
    0,
    NULL },
  { "T-1A",
    &xmPushButtonGadgetClass,
    NULL,
    NULL,
    NULL,
    T1ASurveyDesc,
    0,
    NULL },
  NULL,
};

MenuItem surveyMenu[] =
{
  { "Aircraft Survey Descriptions",
    &xmPushButtonGadgetClass,
    NULL,
    NULL,
    NULL,
    0,
    0,
    aircraftMenu },
  NULL,
```

```
};

MenuItem visionMenu[ ] =
{
   { "Explanation",
     &xmPushButtonGadgetClass,
     NULL,
     NULL,
     NULL,
     DisplayTechInfo,
     (XtPointer)VISION,
     NULL },
   { "Report",
     &xmPushButtonGadgetClass,
     NULL,
     NULL,
     NULL,
     GenerateReport,
     (XtPointer)VISION,
     NULL },
   NULL,
};
MenuItem reachRudderThrowReportMenu[ ] =
{
   { "Explanation",
     &xmPushButtonGadgetClass,
     NULL,
     NULL,
     NULL,
     DisplayTechInfo,
     (XtPointer)REACH_RUDDER_THROW,
     NULL },
   { "Report",
     &xmPushButtonGadgetClass,
     NULL,
     NULL,
     NULL,
     GenerateReport,
     (XtPointer)REACH_RUDDER_THROW,
     NULL },
   NULL,
};
MenuItem reachArmReachIndividualControlsReportMenu[ ] =
{
   { "Explanation",
     &xmPushButtonGadgetClass,
     'E',
     NULL,
     NULL,
     DisplayTechInfo,
     (XtPointer)REACH_ARM_REACH_INDIVIDUAL_CONTROLS,
     NULL },
   { "Report",
     &xmPushButtonGadgetClass,
     'R',
     NULL,
     NULL,
     GenerateReport,
     (XtPointer)REACH_ARM_REACH_INDIVIDUAL_CONTROLS,
     NULL },
   NULL,
};
MenuItem reachArmReachAllMissedControlsReportMenu[ ] =
{
   { "Explanation",
     &xmPushButtonGadgetClass,
```

```
      'E',
      NULL,
      NULL,
      DisplayTechInfo,
      (XtPointer)REACH_ARM_REACH_ALL_MISSED_CONTROLS,
      NULL },
    { "Report",
      &xmPushButtonGadgetClass,
      'R',
      NULL,
      NULL,
      GenerateReport,
      (XtPointer)REACH_ARM_REACH_ALL_MISSED_CONTROLS,
      NULL },
    NULL,
};
MenuItem reachArmReachControlRegionLeftSidePanelReportMenu[ ] =
{
    { "Explanation",
      &xmPushButtonGadgetClass,
      'E',
      NULL,
      NULL,
      DisplayTechInfo,
      (XtPointer)REACH_ARM_REACH_CONTROL_REGION_LEFT_SIDE_PANEL,
      NULL },
    { "Report",
      &xmPushButtonGadgetClass,
      'R',
      NULL,
      NULL,
      GenerateReport,
      (XtPointer)REACH_ARM_REACH_CONTROL_REGION_LEFT_SIDE_PANEL,
      NULL },
    NULL,
};
MenuItem reachArmReachControlRegionLeftAuxiliaryPanelReportMenu[ ] =
{
    { "Explanation",
      &xmPushButtonGadgetClass,
      'E',
      NULL,
      NULL,
      DisplayTechInfo,
      (XtPointer)REACH_ARM_REACH_CONTROL_REGION_LEFT_AUXILIARY_PANEL,
      NULL },
    { "Report",
      &xmPushButtonGadgetClass,
      'R',
      NULL,
      NULL,
      GenerateReport,
      (XtPointer)REACH_ARM_REACH_CONTROL_REGION_LEFT_AUXILIARY_PANEL,
      NULL },
    NULL,
};
MenuItem reachArmReachControlRegionMainInstrumentPanelReportMenu[ ] =
{
    { "Explanation",
      &xmPushButtonGadgetClass,
      'E',
      NULL,
      NULL,
      DisplayTechInfo,
      (XtPointer)REACH_ARM_REACH_CONTROL_REGION_MAIN_INSTRUMENT_PANEL,
      NULL },
```

```
    { "Report",
      &xmPushButtonGadgetClass,
      'R',
      NULL,
      NULL,
      GenerateReport,
      (XtPointer)REACH_ARM_REACH_CONTROL_REGION_MAIN_INSTRUMENT_PANEL,
      NULL },
    NULL,
};
MenuItem reachArmReachControlRegionCenterPedestalReportMenu[ ] =
{
    { "Explanation",
      &xmPushButtonGadgetClass,
      'E',
      NULL,
      NULL,
      DisplayTechInfo,
      (XtPointer)REACH_ARM_REACH_CONTROL_REGION_CENTER_PEDESTAL,
      NULL },
    { "Report",
      &xmPushButtonGadgetClass,
      'R',
      NULL,
      NULL,
      GenerateReport,
      (XtPointer)REACH_ARM_REACH_CONTROL_REGION_CENTER_PEDESTAL,
      NULL },
    NULL,
};
MenuItem reachArmReachControlRegionRightSidePanelReportMenu[ ] =
{
    { "Explanation",
      &xmPushButtonGadgetClass,
      'E',
      NULL,
      NULL,
      DisplayTechInfo,
      (XtPointer)REACH_ARM_REACH_CONTROL_REGION_RIGHT_SIDE_PANEL,
      NULL },
    { "Report",
      &xmPushButtonGadgetClass,
      'R',
      NULL,
      NULL,
      GenerateReport,
      (XtPointer)REACH_ARM_REACH_CONTROL_REGION_RIGHT_SIDE_PANEL,
      NULL },
    NULL,
};
MenuItem reachArmReachControlRegionRightSideAuxiliaryPanelReportMenu[ ] =
{
    { "Explanation",
      &xmPushButtonGadgetClass,
      'E',
      NULL,
      NULL,
      DisplayTechInfo,
      (XtPointer)REACH_ARM_REACH_CONTROL_REGION_RIGHT_AUXILIARY_PANEL,
      NULL },
    { "Report",
      &xmPushButtonGadgetClass,
      'R',
      NULL,
      NULL,
      GenerateReport,
```

```
        (XtPointer)REACH_ARM_REACH_CONTROL_REGION_RIGHT_AUXILIARY_PANEL,
        NULL },
      NULL,
  };
  MenuItem reachArmReachControlRegionMenu[ ] =
  {
      { "Left Side Panel",
        &xmPushButtonGadgetClass,
        'A',
        NULL,
        NULL,
        0,
        0,
        reachArmReachControlRegionLeftSidePanelReportMenu },
      { "Left Auxiliary Panel",
        &xmPushButtonGadgetClass,
        'A',
        NULL,
        NULL,
        0,
        0,
        reachArmReachControlRegionLeftAuxiliaryPanelReportMenu },
      { "Main Instrument Panel",
        &xmPushButtonGadgetClass,
        'A',
        NULL,
        NULL,
        0,
        0,
        reachArmReachControlRegionMainInstrumentPanelReportMenu },
      { "Center Pedestal",
        &xmPushButtonGadgetClass,
        'A',
        NULL,
        NULL,
        0,
        0,
        reachArmReachControlRegionCenterPedestalReportMenu },
      { "Right Side Panel",
        &xmPushButtonGadgetClass,
        'A',
        NULL,
        NULL,
        0,
        0,
        reachArmReachControlRegionRightSidePanelReportMenu },
      { "Right Auxiliary Panel",
        &xmPushButtonGadgetClass,
        'A',
        NULL,
        NULL,
        0,
        0,
        reachArmReachControlRegionRightSideAuxiliaryPanelReportMenu },
      NULL,
  };
  MenuItem reachArmReachMenu[ ] =
  {
      { "Control Region",
        &xmPushButtonGadgetClass,
        'A',
        NULL,
        NULL,
        0,
        0,
        reachArmReachControlRegionMenu }
```

```
    { "Individual Controls",
      &xmPushButtonGadgetClass,
      'R',
      NULL,
      NULL,
      0,
      0,
      reachArmReachIndividualControlsReportMenu },
    { "List All Missed Controls",
      &xmPushButtonGadgetClass,
      'A',
      NULL,
      NULL,
      0,
      0,
      reachArmReachAllMissedControlsReportMenu },
    NULL,
};
MenuItem reachMenu[ ] =
{
    { "Arm Reaches",
      &xmPushButtonGadgetClass,
      'A',
      NULL,
      NULL,
      0,
      0,
      reachArmReachMenu },
    { "Rudder Throw",
      &xmPushButtonGadgetClass,
      'R',
      NULL,
      NULL,
      0,
      0,
      reachRudderThrowReportMenu },
    NULL,
};
MenuItem overheadClearanceReportMenu[ ] =
{
    { "Explanation",
      &xmPushButtonGadgetClass,
      'E',
      NULL,
      NULL,
      DisplayTechInfo,
      (XtPointer)CLEARANCE_OVERHEAD,
      NULL },
    { "Report",
      &xmPushButtonGadgetClass,
      'R',
      NULL,
      NULL,
      GenerateReport,
      (XtPointer)CLEARANCE_OVERHEAD,
      NULL },
    NULL,
};
MenuItem shinClearanceReportMenu[ ] =
{
    { "Explanation",
      &xmPushButtonGadgetClass,
      'E',
      NULL,
      NULL,
      DisplayTechInfo,
```

```
      (XtPointer)CLEARANCE_SHIN_WITH_INSTRUMENT_PANEL,
      NULL },
    { "Report",
      &xmPushButtonGadgetClass,
      'R',
      NULL,
      NULL,
      GenerateReport,
      (XtPointer)CLEARANCE_SHIN_WITH_INSTRUMENT_PANEL,
      NULL },
    NULL,
};
MenuItem glareShieldClearanceReportMenu[ ] =
{
    { "Explanation",
      &xmPushButtonGadgetClass,
      'E',
      NULL,
      NULL,
      DisplayTechInfo,
      (XtPointer)CLEARANCE_EJECTION_WITH_GLARE_SHIELD,
      NULL },
    { "Report",
      &xmPushButtonGadgetClass,
      'R',
      NULL,
      NULL,
      GenerateReport,
      (XtPointer)CLEARANCE_EJECTION_WITH_GLARE_SHIELD,
      NULL },
    NULL,
};
MenuItem canopyBowClearanceReportMenu[ ] =
{
    { "Explanation",
      &xmPushButtonGadgetClass,
      'E',
      NULL,
      NULL,
      DisplayTechInfo,
      (XtPointer)CLEARANCE_EJECTION_WITH_CANOPY_BOW,
      NULL },
    { "Report",
      &xmPushButtonGadgetClass,
      'R',
      NULL,
      NULL,
      GenerateReport,
      (XtPointer)CLEARANCE_EJECTION_WITH_CANOPY_BOW,
      NULL },
    NULL,
};
MenuItem clearanceMenu[] =
{
    { "Overhead",
      &xmPushButtonGadgetClass,
      'O',
      NULL,
      NULL,
      0,
      0,
      overheadClearanceReportMenu },
    { "Shin with Instrument Panel",
      &xmPushButtonGadgetClass,
      'S',
      NULL,
```

```
      NULL,
      0,
      0,
      shinClearanceReportMenu },
    { "Ejection with Glare Shield",
      &xmPushButtonGadgetClass,
      'G',
      NULL,
      NULL,
      0,
      0,
      glareShieldClearanceReportMenu },
    { "Ejection with Canopy Bow",
      &xmPushButtonGadgetClass,
      'C',
      NULL,
      NULL,
      0,
      0,
      canopyBowClearanceReportMenu },
    NULL,
};

MenuItem dataMenu[] =
{
    { "Clearance",
      &xmPushButtonGadgetClass,
      'C',
      NULL,
      NULL,
      0,
      0,
      clearanceMenu },
    { "Reach",
      &xmPushButtonGadgetClass,
      'R',
       NULL,
      NULL,
      0,
      0,
      reachMenu },
    { "Vision",
      &xmPushButtonGadgetClass,
      'V',
      NULL,
      NULL,
      0,
      0,
      visionMenu },
    NULL,
};

MenuItem overheadClearanceMenu[] =
{
    { "For 1 inch clearance overhead",
      &xmPushButtonGadgetClass,
      NULL,
      NULL,
      NULL,
      updateClearanceSelection,
      (XtPointer)ONE_INCH_CLEARANCE_OVERHEAD,
      NULL },
    { "For 2 inch clearance overhead",
      &xmPushButtonGadgetClass,
      NULL,
      NULL,
```

```
        NULL,
        updateClearanceSelection,
        (XtPointer)TWO_INCH_CLEARANCE_OVERHEAD,
        NULL },
    { "For 3 inch clearance overhead",
        &xmPushButtonGadgetClass,
        NULL,
        NULL,
        NULL,
        updateClearanceSelection,
        (XtPointer)THREE_INCH_CLEARANCE_OVERHEAD,
        NULL },
    { "For 4 inch clearance overhead",
        &xmPushButtonGadgetClass,
        NULL,
        NULL,
        NULL,
        updateClearanceSelection,
        (XtPointer)FOUR_INCH_CLEARANCE_OVERHEAD,
        NULL },
    NULL,
};
```

constants.h

```c
#define dialogBGColor             "darkslategray"
#define dialogSectionBGColor      "dimgray"
#define dialogSectionTitleColor   "lightgray"
#define dialogFillInFieldColor    "wheat"

/***************************************************************
 *                    Maximun number of Aircraft               *
 ***************************************************************/
#define MAX_AIRCRAFT       500


/***************************************************************
 *                Aircraft identification codes                *
 ***************************************************************/
#define F_16_A         1
#define C_141_A        2
#define T_37_B         3
#define T_38_A         4
#define T_1_A          5


/***************************************************************
 *              Crewstation identification codes               *
 ***************************************************************/
#define CREW_LEFT      1
#define CREW_RIGHT     2
#define CREW_FORWARD   3
#define CREW_AFT       4


/***************************************************************
 *                     Limiting Parmeters                      *
 ***************************************************************/
#define MAX_LENGTH_OF_AIRCRAFT_NAME      10
#define MAX_SEAT_ADJ_DIRECTIONS           2
#define MAX_CREW_STATIONS_PER_AIRCRAFT   20
#define MAX_LENGTH_OF_CREWSTATION_NAME   20
#define MAX_MEASUREMENTS_TAKEN            6


/***************************************************************
 *      Seat adjustment direction identification codes        *
 ***************************************************************/
#define VERTICAL       1
#define HORIZONTAL     2


/***************************************************************
 *     Codes for each database or tech information query      *
 ***************************************************************/
#define CLEARANCE_OVERHEAD                                   1
#define CLEARANCE_SHIN_WITH_INSTRUMENT_PANEL                 2
#define CLEARANCE_EJECTION_WITH_GLARE_SHIELD                 3
#define CLEARANCE_EJECTION_WITH_CANOPY_BOW                   4
#define REACH_ARM_REACH_CONTROL_REGION_LEFT_SIDE_PANEL       5
#define REACH_ARM_REACH_CONTROL_REGION_LEFT_AUXILIARY_PANEL  6
#define REACH_ARM_REACH_CONTROL_REGION_MAIN_INSTRUMENT_PANEL 7
#define REACH_ARM_REACH_CONTROL_REGION_CENTER_PEDESTAL       8
#define REACH_ARM_REACH_CONTROL_REGION_RIGHT_SIDE_PANEL      9
#define REACH_ARM_REACH_CONTROL_REGION_RIGHT_AUXILIARY_PANEL 10
#define REACH_ARM_REACH_INDIVIDUAL_CONTROLS                  11
#define REACH_ARM_REACH_ALL_MISSED_CONTROLS                  12
#define REACH_RUDDER_THROW                                   13
#define VISION                                               14

/*******************************************************************
```

```
 *Seat adjustment overhead clearance selection identification codes *
 ***********************************************************************/
#define ONE_INCH_CLEARANCE_OVERHEAD      1
#define TWO_INCH_CLEARANCE_OVERHEAD      2
#define THREE_INCH_CLEARANCE_OVERHEAD    3
#define FOUR_INCH_CLEARANCE_OVERHEAD     4
```

APPENDIX G

PROGRAM CINPUT

```
      program cinput

      logical*1 airflag,sbjflag,inflag,okflag,regflag
      logical*1 seatflag,loopflag,chkflag,doneflag
      character*1 inchar,crew(4)
      character*8 aname
      character*10 acat
      character*60 inline
      character*12 filename

      integer crewcnt,icnt,regcnt(2),crewidx
      integer region(4,12)
      integer crewst(4)

      character*1 regchar(4)
      data regchar /'y','Y','n','N'/

      character*1 catchar(6)
      data catchar /'f','F','c','C','t','T'/

      character*1 crewchar(8)
      data crewchar /'f','F','a','A','l','L','r','R'/

      integer crewin(8)
      data crewin /3,3,4,4,1,1,2,2/

      character*10 crewname(4)
      data crewname /'LEFT', 'RIGHT', 'FORWARD', 'AFT'/

      character*30 regname(12)
      data regname /'LEFT-SIDE-PANEL', 'LEFT-AUXILIARY-PANEL',
     1 'MAIN-INSTRUMENT-PANEL','CENTER-PEDESTAL','RIGHT-AUXILIARY-PANEL',
     1 'RIGHT-SIDE-PANEL','OVERHEAD-CONTROL-PANEL','LEFT-BULKHEAD',
     1 'RIGHT-BULKHEAD','GLARE-SHIELD','CONTROL-STICK','SEAT'/

      integer seatcnt(4),seatidx
      character*1 seattype(4,3)
      real seatinc(4,3)
      real seatrang(4,3)

      character*1 seatadj(4,3)

      character*1 seatchar(6)
      data seatchar /'V','v','H','h','T','t'/

      character*2 sadjtyp(4)
      data sadjtyp /'C','c','N','n'/

      character*10 seatname(6)
      data seatname /'VERTICAL', 'VERTICAL','HORIZONTAL','HORIZONTAL',
     1              'SEAT-TILT','SEAT-TILT'/

      character*1 contchar(8)
      data contchar/ 'G', 'g', 'F', 'f', 'H', 'h', 'T', 't'/
```

```
          character*1 handchar(6)
          data handchar/ 'R', 'r', 'L', 'l', 'B', 'b'/

          character*1 incont,inhand
          integer contcnt(4,12)

          character*60 contname(4,12,100)
          character*1 conttype(4,12,100)
          character*1 conthand(4,12,100)

          airflag = .false.
          sbjflag = .false.
          inflag = .true.

          do 15 while (inflag)

          write(*,1)
1         format(///,5x,'Data will be accepted in upper or lower case')

          write (*,3)
3         format(//,'     What type of data would you like to enter?',/)
          write (*,5)
5         format($,'     Enter "A" for aircraft data or "S" for subject da
          read (*,10) inchar
10        format(a1)

          if ( (inchar .eq. 'A') .or. (inchar .eq. 'a') ) then
             airflag = .true.
             inflag = .false.
          elseif ( (inchar .eq. 'S') .or. (inchar .eq. 's') ) then
             sbjflag = .true.
             inflag = .false.
          endif

15        end do

          inflag = .true.

C *** Enter Aircraft Data

          if (airflag) then

             write(*,20)
20           format(//,$,'     Aircraft Name: ' )

             read(*,25)aname
25           format(a8)

             if (aname .eq. ' ' ) then
                doneflag = .true.
             endif

             if (.not. doneflag) then

             open(unit=20,file=aname,status='new')
```

```
      write(20,27)aname
27    format(2x,'ANAME       ',2x,a8)

C *** Enter Aircraft Category

      write(*,30)
30    format(//,'     Aircraft category: ')

      inflag = .true.

      do while (inflag)

         write(*,35)
35       format(/,$,'     F(ighter), C(argo), T(rainer): ')

         read(*,36)acat
36       format(a10)

         do i=1,6
            if (acat .eq. catchar(i))then
             inflag = .false.
             write(20,37)acat
37           format(2x,'CATEGORY    ',2x,a10)
          endif
         end do

         if (inflag) then
            write(*,38)
38        format('     **Invalid category, please re-enter**')
         endif

      end do

C *** station

         inflag = .true.
         crewidx = 1

         do 1000 while (inflag)

           write(*,40)
40         format(//,'     Enter Crewstation, <cr> when done ')

         write(*,45)
45       format(/,$'     F(orward), A(ft), L(eft), R(ight): ')

         read(*,50)crew(crewidx)
50       format(a1)

         if (crew(crewidx) .eq. ' ') then
               inflag = .false.
         else
            okflag = .false.
            do i = 1,8
```

```
                  if ( crew(crewidx) .eq. crewchar(i) ) then
                     okflag = .true.
                     crewst(crewidx) = crewin(i)
                  endif
               end do

               if (.not. okflag) then
                  write(*,52)
52                format(/,5x,'***Invalid crewstation - reenter***')

               else

                do i = 1,crewcnt
                  if (crewst(crewidx) .eq. crewst(i)) then
                     okflag = .false.
                     write(*,56)
56                   format(/,5x,
     1               '***This crewstation has already been selected***
                  endif
                end do

            endif

            if (okflag) then

                  write(*,55)crewname(crewst(crewidx))
55                format(/,5x,'CREWSTATION SELECTED: ',a10)

                        crewcnt = crewidx

c *** Regions Within The Selected Crewstation ***

                        regcnt(crewcnt) = 0
                  write(*,60)
60                format(/,
     1            Is this control region applicable? Y(es) or N(o)',/)

                  do k=1,12
                    loopflag = .true.
                    do while (loopflag)
                     write(*,65)regname(k)
65                   format($,5x,a30,': ')
                     read(*,70)inchar
70                   format(a1)
                     if ( ( inchar .eq. 'y') .or.
     1                    (inchar .eq. 'Y')) then
                        regcnt(crewcnt) = regcnt(crewcnt) + 1
                        region(crewidx,regcnt(crewcnt)) = k
                        loopflag = .false.
                     elseif ( ( inchar .eq. 'n') .or.
     1                      (inchar .eq. 'N') )then
                        loopflag = .false.
                     endif
                  end do  !while loopflag
               end do
```

```
C                     else
C
C                        if (.not. okflag) write(*,100)
C100                     format('      **Invalid crewstation, re-enter**')
                      endif

                   endif

C *** Seat Adjustment Data

                   loopflag = .true.
                   icnt = 1

                 do while (loopflag .and. inflag .and. okflag .and.
     1             (icnt .le. 3))

                    write(*,120)
120                 format(//5x,'Seat Adjustment Data')

                    write(*,125)
125                 format(5x,'Each Direction will be Processed Separately')

                  write(*,135)
135               format(/,$,5x,'V(ertical), H(orizontal), T(ilt Seat): ')

                  read(*,140)seatadj(crewidx,icnt)
140               format(a1)

                  okflag = .true.

                  if (seatadj(crewidx,icnt) .eq. ' ') then
                     if (icnt .ne. 1) then
                        loopflag = .false.
c                       seatcnt = icnt -1
                     endif
                  else
                     okflag = .false.
                     do i=1,6
                        if (seatadj(crewidx,icnt) .eq. seatchar(i)) then
                         okflag = .true.
                         seatidx = i
                        endif
                     end do

                     if (.not. okflag) then

                     write(*,250)
250                  format('      **Invalid seat direction, please re-enter**
                     okflag = .true.

                     else

                        write(*,150)seatname(seatidx)
150                     format(/,5x,'SEAT DIRECTION: ',a10)
```

```
                         write(*,160)
160                      format(/,5x,
     1                   'Select Type of Adjustment for this Direction: ')

                         seatflag = .true.

                         do while (seatflag)

                         seatcnt(crewidx) = seatcnt(crewidx) + 1

                         write(*,170)
170                      format(/,$,5x,'C(ontinuous) or N(otched): ')

                         read(*,180)seattype(crewidx,icnt)
180                      format(a1)

                         do n = 1,4
                          if (seattype(crewidx,icnt) .eq. sadjtyp(n)) then
                               seatflag = .false.
                            end if
                         end do

                         if (seatflag) then
                          write(*,185)
185                       format(5x,'**invalid entry - please re-enter**')
                         end if

                         end do

                         seatflag = .true.

                         do while (seatflag)

                         write(*,190)
190                            format(/,$,5x,
     1                         'Enter Increment for One Seat Adjustment: ')

                         read (*,200,err=205)seatinc(crewidx,icnt)
200                      format(f5.0)

                         if (seatinc(crewidx,icnt) .gt. 0.0) seatflag = .false

205                        if (seatflag) then
                          write(*,185)
                           end if

                         end do

                         seatflag = .true.

                         do while (seatflag)

                         write(*,210)
210                            format(/,$,5x,
```

```
     1          'Enter Seat Travel in inches from Full-up to Full-down: '

                     read (*,220,err=225)seatrang(crewidx,icnt)
 220                 format(f5.0)

                     if (seatrang(crewidx,icnt) .gt. 0.0) seatflag = .fal

 225                   if (seatflag) then
                      write(*,185)
                       end if

                     end do

                     icnt = icnt + 1

                  end if

               end if

               end do

               crewidx = crewidx + 1

1000         end do

c *** Control Data Processing ***

            inflag = .true.

            do 4000 while ( (inflag) .and. (crewcnt .ne. 0))

               do 3500 i = 1,crewcnt

                  if (regcnt(i) .ne. 0) then

                  do 3000 j = 1,regcnt(i)

                     loopflag = .true.
                     contcnt(i,j) = 0
                     contnum = 0

                     write(*,2100)
2100                 format(/,5x,'Enter control data for: ')

                   do 2900 while (loopflag)

                     write(*,2110)crewname(crewst(i)),regname(region(i,j))
2110                 format(/,5x,'CREWSTATION: ',a10,' REGION: ',a30)

                     write(*,2120)
2120                 format(5x,
     1               'Control Names are 60 chars max, use dashes as delimiter

                     write(*,2122)
```

```
2122                    format(/,5X,$,'Control Name: ')

                        contnum = contnum + 1

                        read(*,2125)contname(i,j,contnum)
2125                    format(a60)

                        if (contname(i,j,contnum) .eq. ' ') then
                           loopflag = .false.
                        else

                        contcnt(i,j) = contcnt(i,j) + 1

                        inflag = .true.

                        do while (inflag)

                           write(*,2135)
2135                             format(/,$,'     G(rip), F(inger), H(ook), T(

                           read(*,2140)incont
2140                       format(al)

                           do k=1,8
                              if (incont .eq. contchar(k)) then
                               inflag = .false.
                               conttype(i,j,contnum) = incont
                            endif
                                 end do

                                 if (inflag) then
                           write(*,2145)
2145                       format('     **Invalid control type, please re-ente
                                 endif

                       end do

c *** Which hand reaches this control? ***

                        inflag = .true.

                        do while (inflag)

                           write(*,2150)
2150                             format(/,$,'     R(ight), L(eft), B(oth): ')

                           read(*,2155)inhand
2155                       format(al)

                           do k=1,6
                              if (inhand .eq. handchar(k)) then
                               inflag = .false.
                               conthand(i,j,contnum) = inhand
                            endif
                                 end do
```

```
                         if (inflag) then
                   write(*,2165)
 2165              format('     **Invalid hand, please re-enter**')
                         endif

                end do

                endif  !if contname .ne. ' '

 2900          end do  !while loopflag

 3000          end do

                endif

 3500          end do

 4000       end do

C *** write out aircraft file ***

           write(20,4010)crewcnt
 4010      format(2x,'CREWCNT       ',2x,i2)

           do 4900 i = 1,crewcnt

              write(20,4015)crewst(i)
 4015         format(3x,'CREWSTATION ',2x,i2)

              write(20,4017)seatcnt(i)
 4017         format(4x,'SEATCNT      ',2x,il)

              do 4050 l = 1,3
                if ( (seattype(i,l) .eq. 'c') .or. (seattype(i,l) .eq. 'C'
     1          .or. (seattype(i,l) .eq. 'n') .or. (seattype(i,l) .eq. 'N'
                 write(20,4020)seatadj(i,l)
 4020            format(5x,'SEATADJ      ',2x,al)
                 write(20,4030)seattype(i,l)
 4030            format(6x,'SEATTYPE     ',2x,al)
                 write(20,4035)seatinc(i,l)
 4035            format(6x,'SEATINC      ',2x,f7.3)
                 write(20,4040)seatrang(i,l)
 4040            format(6x,'SEATRANGE    ',2x,f7.3)
                endif
 4050         end do

              write(20,4055)regcnt(i)
 4055         format(4x,'REGCNT       ',2x,i2)

              do 4800 j = 1,regcnt(i)

                 write(20,4060)region(i,j)
 4060            format(5x,'REGNUM       ',2x,i2)
```

```
           write(20,4070)contcnt(i,j)
4070       format(6x,'CONTCNT     ',2x,i3)

        do 4700 k=1,contcnt(i,j)
           write(20,4080)contname(i,j,k)
4080       format(7x,'CONTNAME    ',2x,a60)
           write(20,4090)conttype(i,j,k)
4090       format(8x,'CONTTYPE    ',2x,a1)
           write(20,4100)conthand(i,j,k)
4100       format(8x,'CONTHAND    ',2x,a1)

4700    end do

4800   end do

4900    end do

      end if  !if .not. doneflag

      close(unit=20)

      else

         call subject

      end if  ! if airflag

      write(*,5000)
5000  format(//,5x,'***Exiting Cockpit Input Program***',///)

      end

      subroutine subject

      logical*1 sbjflag,inflag,okflag,loopflag,doneflag,zoneflag

      character*1 inchar
      character*8 aname
      character*12 inline(2)
      character*16 filename
      character*30 sbjname

      integer sbjnum
      integer zone

      real acrhtsit, buttknee, kneehtst, sitht, eyehtsit
      real stature, weight, shldrbrt
      real ttreach(2), ttgrip(2), ttfing(2), tthook(2), ttthumb(2)

      integer crewcnt,seatcnt,regcnt(2)
      integer region(4,12)
      integer crewst(4)
      integer crewidx, regidx,contidx

      integer ccount
```

```
      integer contnum(4,12,100)
      integer contcnt(4,12)
      real contdata(4,12,100,2,2)

      character*60 contname(4,12,100)
      character*1 conttype(4,12,100)
      character*1 conthand(4,12,100)

      character*1 crewchar(8)
      data crewchar /'f','F','a','A','l','L','r','R'/

      integer crewin(8)
      data crewin /3,3,4,4,1,1,2,2/

      character*10 crewname(4)
      data crewname /'LEFT', 'RIGHT', 'FORWARD', 'AFT'/

      character*30 regname(12)
      data regname /'LEFT-SIDE-PANEL', 'LEFT-AUXILIARY-PANEL',
     1 'MAIN-INSTRUMENT-PANEL','CENTER-PEDESTAL','RIGHT-AUXILIARY-PANEL
     1 'RIGHT-SIDE-PANEL','OVERHEAD-CONTROL-PANEL','LEFT-BULKHEAD',
     1 'RIGHT-BULKHEAD','GLARE-SHIELD','CONTROL-STICK','SEAT'/

      inflag = .true.

C *** Enter Aircraft Data

         write(*,20)
20       format(//,$,'     Aircraft Name: ' )

         read(*,25)aname
25       format(a8)

         if (aname .eq. ' ' ) then
            doneflag = .true.
         endif

         if (.not. doneflag) then

            okflag = .false.

            open(unit=20,file=aname,status='old',err=30,readonly)
c     1     mode='read',err=30)

            filename(1:8)='subject.'
            filename(9:16)=aname
            open(unit=21,file=filename,access='append',status='unkno
     1      err=30)
            okflag = .true.

30          if (.not. okflag) then
            write(*,50)
50          format(//,5x,'***File Open Error-Check Aircraft Data File

            else
```

```
                 write(21,60)aname
60               format(2x,'ANAME         ',2x,a8)

c *** read aname, category ***

                   read(20,70)inline(1),inline(2)
70                 format(2x,a12,2x,a8)

                   read(20,72)inline(1),inline(2)
72                 format(2x,a12,2x,a1)


c *** read crewcnt ***

                 read(20,75)inline(1),crewcnt
75               format(2x,a12,2x,i2)


                 do 300 i = 1,crewcnt

                   read(20,80)inline(1),crewst(i)
80                 format(3x,a12,2x,i2)

                   read(20,90)inline(1),seatcnt
90                 format(4x,a12,2x,i1)

                   do j = 1,seatcnt
                     do k = 1,4
                     read(20,100)inline(1),inline(2)
100                  format(a12,2x,a12)
                     end do
                   end do

                   read(20,110)inline(1),regcnt(i)
110                format(4x,a12,2x,i2)

                   ccount = 1

                   do 200 j = 1,regcnt(i)

                     read(20,120)inline(1),region(i,j)
120                  format(5x,a12,2x,i2)

                     read(20,130)inline(1),contcnt(i,j)
130                  format(6x,a12,2x,i3)

                     do 180 k = 1, contcnt(i,j)

                       read(20,140)inline(1),contname(i,j,k)
140                    format(7x,a12,2x,a60)
                       read(20,150)inline(1),conttype(i,j,k)
150                    format(8x,a12,2x,a1)
                       read(20,160)inline(1),conthand(i,j,k)
160                    format(8x,a12,2x,a1)
```

```
                           contnum(i,j,k) = ccount
                           ccount = ccount + 1

180                     end do


200                  end do

300               end do

c ***Input Subject Data***

                  inflag = .true.

                  do 2000 while (inflag)

                     sbjnum = 0

1069                 write(*,1070)
1070                 format(//,5x,$,'Subject Number: ')

                     read(*,1075,err=1069)sbjnum
1075                 format(i4)

                     if (sbjnum .eq. 0) then
                        inflag = .false.
                     endif

                     if (inflag) then

                     write(*,1080)
1080                 format(/,5x,$,'Subject Name: ')

                     read(*,1085)sbjname
1085                 format(a30)

                     write(*,1090)
1090                 format(//,5x,'ENTER SUBJECT ANTHROPOMETRY')

1094                 write(*,1095)
1095                 format(/,5x,$,'Stature:  ')

                     read(*,1100,err=1094)stature
1100                 format(f10.0)

1109                 write(*,1110)
1110                 format(/,5x,$,'Weight:  ')

                     read(*,1100,err=1109)weight

1114                 write(*,1115)
1115                 format(/,5x,$,'Sitting-Height:  ')

                     read(*,1100,err=1114)sitht
```

```
1119              write(*,1120)
1120              format(/,5x,$,'Eye-Height-Sitting:  ')

                  read(*,1100,err=1119)eyehtsit

1124              write(*,1125)
1125              format(/,5x,$,'Acromion-Height-Sitting:  ')

                  read(*,1130,err=1124)acrhtsit
1130              format(f5.0)

1134              write(*,1135)
1135              format(/,5x,$,'Buttock-Knee-Length:  ')

                  read(*,1100,err=1134)buttknee

1136              write(*,1137)
1137              format(/,5x,$,'Knee-Height-Sitting:  ')

                  read(*,1100,err=1136)kneehtst

1139              write(*,1140)
1140              format(/,5x,$,'Shoulder-Breadth:  ')

                  read(*,1100,err=1139)shldrbrt

                  write(*,1142)
1142              format(//,5x,'LEFT HAND DATA')

1144              write(*,1145)
1145              format(/,5x,$,'Thumb-Tip-Reach:  ')

                  read(*,1100,err=1144)ttreach(1)

1164              write(*,1165)
1165              format(/,5x,$,'X to Grip:  ')

                  read(*,1100,err=1164)ttgrip(1)

1149              write(*,1150)
1150              format(/,5x,$,'X to Finger:  ')

                  read(*,1100,err=1149)ttfing(1)

1154              write(*,1155)
1155              format(/,5x,$,'X to Hook:  ')

                  read(*,1100,err=1154)tthook(1)

1159              write(*,1160)
1160              format(/,5x,$,'X to Thumb:  ')

                  read(*,1100,err=1159)ttthumb(1)

                  write(*,1170)
```

```
1170                format(//,5x,'RIGHT HAND DATA')

1239                write(*,1240)
1240                format(/,5x,$,'Thumb-Tip-Reach:  ')

                    read(*,1100,err=1239)ttreach(2)

1259                write(*,1260)
1260                format(/,5x,$,'X to Grip:  ')

                    read(*,1100,err=1259)ttgrip(2)

1244                write(*,1245)
1245                format(/,5x,$,'X to Finger:  ')

                    read(*,1100,err=1244)ttfing(2)

1249                write(*,1250)
1250                format(/,5x,$,'X to Hook:  ')

                    read(*,1100,err=1249)tthook(2)

1254                write(*,1255)
1255                format(/,5x,$,'X to Thumb:  ')

                    read(*,1100,err=1254)ttthumb(2)

                    write(21,1265)sbjnum,sbjname,stature,weight,
     1                 sitht,eyehtsit,  acrhtsit,buttknee,kneehtst,shldrbr
1265                   format(2x,i3,2x,a30,/,2x,8(f10.3,2x))

                    write(21,1268)(ttreach(kk),ttgrip(kk),ttfing(kk),
     1                    tthook(kk),ttthumb(kk),kk=1,2)
1268                   format(5(2x,f10.3))

                    sbjflag = .true.

                    write(*,1270)
1270                format(//,5x,'Enter Subject Reach Data',//)

                 do while (sbjflag)

                    write(*,1275)
1275                format(//,5x,$,
     1              'For Crewstation F(orward), A(ft), L(eft), R(ight):')

                    read(*,1280)inchar
1280                format(a1)

                    okflag = .false.

                    if (inchar .eq. ' ') then
                       sbjflag = .false.
                    else
                       do i = 1,8
```

```
                  if (inchar .eq. crewchar(i)) then
                     do n = 1,crewcnt
                        if (crewin(i) .eq. crewst(n)) then
                           okflag = .true.
                                 crewidx = n
                        end if
                     end do
                  end if
               end do

               if ( .not. okflag ) then

               write(*,1300)
1300           format(5x,'No Data Available for this Crewstation')

               end if

            end if

         if ( (sbjflag) .and. (okflag) ) then

            write(*,1310)crewname(crewst(crewidx))
1310        format(/,5x,'Subject Data for Crewstation: ',a10)

            loopflag = .true.

            do 1600 while (loopflag)

              zone = 0

              write(*,1320)
1320          format(/,5x,$,'Enter data for which Zone? (1 or 2):

              read(*,1330,err=1600)zone
1330          format(i1)

              if (zone .eq. 0) then
               loopflag = .false.

              else if ((zone .eq. 1) .or. (zone .eq. 2)) then


            do 1500 ihand = 1,2

            do 1400 k=1,regcnt(crewidx)

               do 1395 j=1,contcnt(crewidx,k)

                  if ( ( (ihand .eq. 1) .and.
                     ( (conthand(crewidx,k,j) .eq. 'L' ) .or.
                     (conthand(crewidx,k,j) .eq. 'l' ) .or.
                     (conthand(crewidx,k,j) .eq. 'B' ) .or.
                     (conthand(crewidx,k,j) .eq. 'b' ) ) ) .or.
                       ( (ihand .eq. 2) .and.
                     ( (conthand(crewidx,k,j) .eq. 'R' ) .or.
```

```
     1                          (conthand(crewidx,k,j) .eq. 'r' ) .or.
     1                          (conthand(crewidx,k,j) .eq. 'B' ) .or.
     1                          (conthand(crewidx,k,j) .eq. 'b' ) ) ) )then

                    if (ihand .eq. 1) then

                       write(*,1360)crewname(crewst(crewidx)),zone
1360                   format(//,5x,'Crewstation: ',a10,' Zone: ',i1,
     1                 ' Left Hand Data')

                    elseif (ihand .eq. 2) then

                       write(*,1365)crewname(crewst(crewidx)),zone
1365                   format(//,5x,'Crewstation: ',a10,' Zone: ',i1,
     1                 ' Right Hand Data')

                    endif

                          write(*,1370)contname(crewidx,k,j)
1370                      format(5x,'Control: ',a60)

                          write(*,1375)regname(region(crewidx,k)),
     1                             conttype(crewidx,k,j)
1375                      format(5x,'Region: ',a30,' Control Type: ',a1)

1379                      write(*,1380)
1380                      format(/,5x,$,'Measured Reach: ')

                          read(*,1385,err=1379)contdata(crewidx,k,j,zone
1385                      format(f10.0)

                          write(21,1390)crewin(crewidx),region(crewidx,k
     1                    contnum(crewidx,k,j),contname(crewidx,k,j),zon
     1                    ihand,contdata(crewidx,k,j,zone,ihand)
1390                      format(2x,i2,2x,i2,2x,i3,2x,a60,/,
     1                         3x,i1,2x,i1,2x,f10.3)

                       endif

1395                   end do

1400               end do

1500            end do

                endif

1600            end do

                endif       !if sbjflag and okflag

              end do  !if sbjflag

          write(21,1900)
1900      format(2x,'-1',2x,'-1',2x,'-1 ')
```

```
        endif    !if inflag

2000    end do

        endif    !if not okflag

        endif  !if not doneflag

c *** Enter Subject's Reach Data ***

        return
        end
```

CINPUT AIRCRAFT DATA FILE

```
ANAME              T-38A
CATEGORY           T
CREWCNT             2
 CREWSTATION         3
  SEATCNT            2
   SEATADJ            V
    SEATTYPE           C
    SEATINC              0.1
    SEATRANGE            4.8
   SEATADJ            V
    SEATTYPE           C
    SEATINC              0.1
    SEATRANGE            4.8
  REGCNT              8
   REGNUM              1
    CONTCNT              1
     CONTNAME          THROTTLE-FWD
      CONTTYPE           H
      CONTHAND           L
   REGNUM              2
    CONTCNT              6
     CONTNAME          FUEL-SHUTOFF-SWITCH-LEFT
      CONTTYPE           F
      CONTHAND           L
     CONTNAME          ENGINE-START-BUTTON-LEFT
      CONTTYPE           F
      CONTHAND           L
     CONTNAME          LANDING-GEAR-ALT-REL-HANDLE
      CONTTYPE           H
      CONTHAND           L
     CONTNAME          RADIO-TRANSFER-SWITCH-NAV
      CONTTYPE           F
      CONTHAND           L
     CONTNAME          INTERCOMM-SWITCH-ILS
      CONTTYPE           T
      CONTHAND           L
     CONTNAME          PITOT-HEAT-SWITCH
      CONTTYPE           F
      CONTHAND           B
   REGNUM              3
    CONTCNT              7
     CONTNAME          LANDING-GEAR-LEVER
      CONTTYPE           F
      CONTHAND           L
     CONTNAME          DOWNLOCK-OVERRIDE-BUTTON
      CONTTYPE           F
      CONTHAND           L
     CONTNAME          AIRSPEED/MACH-INDICATOR
      CONTTYPE           T
      CONTHAND           L
     CONTNAME          STEERING-MODE-SWITCH-NORM
      CONTTYPE           F
      CONTHAND           L
     CONTNAME          HSI-HEADING-SET-KNOB
      CONTTYPE           T
```

```
      CONTHAND         B
     CONTNAME        HSI-COURSE-SET-KNOB
      CONTTYPE         T
      CONTHAND         B
     CONTNAME        MASTER-CAUTION
      CONTTYPE         F
      CONTHAND         B
   REGNUM           4
    CONTCNT            4
     CONTNAME        UHF-COMMAND-RADIO-CONTROL-MAIN
      CONTTYPE         T
      CONTHAND         B
     CONTNAME        TACAN-CONTROL-CHANNEL-KNOB
      CONTTYPE         T
      CONTHAND         B
     CONTNAME        RUDDER-PEDAL-ADJUST-T-HANDLE
      CONTTYPE         H
      CONTHAND         B
     CONTNAME        CIRCUIT-BREAKER-LWR-CTR
      CONTTYPE         T
      CONTHAND         B
   REGNUM           5
    CONTCNT            3
     CONTNAME        FUEL-OXYGEN-CHECK-SWITCH
      CONTTYPE         H
      CONTHAND         R
     CONTNAME        CANOPY-JETTISON-T-HANDLE
      CONTTYPE         H
      CONTHAND         R
     CONTNAME        GENERATOR-SWITCH-LEFT
      CONTTYPE         F
      CONTHAND         R
   REGNUM           6
    CONTCNT            3
     CONTNAME        OXYGEN-SUPPLY-SWITCH-EMERGENCY
      CONTTYPE         F
      CONTHAND         R
     CONTNAME        IFF-CONTROL-MASTER-KNOB
      CONTTYPE         T
      CONTHAND         R
     CONTNAME        LIGHTING-CONTROL-EXTERIOR
      CONTTYPE         F
      CONTHAND         R
   REGNUM          11
    CONTCNT            2
     CONTNAME        CONTROL-STICK-NEUTRAL
      CONTTYPE         G
      CONTHAND         R
     CONTNAME        CONTROL-STICK-FULL-FWD-LEFT
      CONTTYPE         G
      CONTHAND         R
   REGNUM          12
    CONTCNT            3
     CONTNAME        SEAT-ADJUST-SWITCH
      CONTTYPE         F
```

```
        CONTHAND        R
      CONTNAME        INERTIA-REEL-LOCK-LEVER
        CONTTYPE        T
        CONTHAND        L
      CONTNAME        EJECTION-HAND-GRIPS
        CONTTYPE        G
        CONTHAND        B
CREWSTATION     4
 SEATCNT        1
  SEATADJ        V
   SEATTYPE        C
   SEATINC          0.1
   SEATRANGE        4.3
 REGCNT          8
  REGNUM          1
   CONTCNT          1
    CONTNAME        THROTTLE-FWD
     CONTTYPE        H
     CONTHAND        L
  REGNUM          2
   CONTCNT          2
    CONTNAME        ENGINE-START-BUTTON-LEFT
     CONTTYPE        F
     CONTHAND        L
    CONTNAME        INTERCOMM-SWITCH-ILS
     CONTTYPE        T
     CONTHAND        L
  REGNUM          3
   CONTCNT          6
    CONTNAME        LANDING-GEAR-LEVER
     CONTTYPE        F
     CONTHAND        L
    CONTNAME        DOWNLOCK-OVERRIDE-BUTTON
     CONTTYPE        F
     CONTHAND        L
    CONTNAME        AIRSPEED/MACH-INDICATOR
     CONTTYPE        T
     CONTHAND        L
    CONTNAME        HSI-HEADING-SET-KNOB
     CONTTYPE        T
     CONTHAND        B
    CONTNAME        HSI-COURSE-SET-KNOB
     CONTTYPE        T
     CONTHAND        B
    CONTNAME        MASTER-CAUTION
     CONTTYPE        F
     CONTHAND        B
  REGNUM          4
   CONTCNT          3
    CONTNAME        UHF-COMMAND-RADIO-CONTROL-MAIN
     CONTTYPE        T
     CONTHAND        B
    CONTNAME        TACAN-CONTROL-CHANNEL-KNOB
     CONTTYPE        T
     CONTHAND        B
```

```
    CONTNAME        RUDDER-PEDAL-ADJ-T-HANDLE
      CONTTYPE        H
      CONTHAND        B
REGNUM            5
  CONTCNT           0
REGNUM            6
  CONTCNT           2
    CONTNAME        OXYGEN-SUPPLY-SWITCH-EMERGENCY
      CONTTYPE        F
      CONTHAND        R
    CONTNAME        LIGHTING-CONTROL-COCKPIT-FLOODS
      CONTTYPE        F
      CONTHAND        R
REGNUM           11
  CONTCNT           2
    CONTNAME        CONTROL-STICK-NEUTRAL
      CONTTYPE        G
      CONTHAND        R
    CONTNAME        CONTROL-STICK-FULL-FWD-LEFT
      CONTTYPE        G
      CONTHAND        R
REGNUM           12
  CONTCNT           3
    CONTNAME        SEAT-ADJUST-SWITCH
      CONTTYPE        F
      CONTHAND        R
    CONTNAME        INERTIA-REEL-LOCKING-LEVER
      CONTTYPE        T
      CONTHAND        L
    CONTNAME        EJECTION-HAND-GRIPS
      CONTTYPE        G
      CONTHAND        B
```

CINPUT SUBJECT DATA FILE

```
ANAME          T-38A
  1  WARD
    62.500     116.000       32.700       29.100       22.300       22.500
.000        13.000
    28.000        2.560        7.060        6.250        4.750
    26.800        3.125        7.500        6.750        5.190
  3   1    1  THROTTLE-FWD
  1  1       9.250
  3   2    2  FUEL-SHUTOFF-SWITCH-LEFT
  1  1      15.000
  3   2    3  ENGINE-START-BUTTON-LEFT
  1  1      14.250
  3   2    4  LANDING-GEAR-ALT-REL-HANDLE
  1  1      11.500
  3   2    5  RADIO-TRANSFER-SWITCH-NAV
  1  1      12.500
  3   2    6  INTERCOMM-SWITCH-ILS
  1  1      12.500
  3   2    7  PITOT-HEAT-SWITCH
  1  1      14.750
  3   3    8  LANDING-GEAR-LEVER
  1  1       9.875
  3   3    9  DOWNLOCK-OVERRIDE-BUTTON
  1  1      11.500
  3   3   10  AIRSPEED/MACH-INDICATOR
  1  1      11.375
  3   3   11  STEERING-MODE-SWITCH-NORM
  1  1      10.875
  3   3   12  HSI-HEADING-SET-KNOB
  1  1      10.750
  3   3   13  HSI-COURSE-SET-KNOB
  1  1      11.000
  3   3   14  MASTER-CAUTION
  1  1      13.500
  3   4   15  UHF-COMMAND-RADIO-CONTROL-MAIN
  1  1      12.750
  3   4   16  TACAN-CONTROL-CHANNEL-KNOB
  1  1      13.625
  3   4   17  RUDDER-PEDAL-ADJUST-T-HANDLE
  1  1      15.000
  3   4   18  CIRCUIT-BREAKER-LWR-CTR
  1  1      17.000
  3  12   28  INERTIA-REEL-LOCK-LEVER
  1  1       8.875
  3  12   29  EJECTION-HAND-GRIPS
  1  1       0.000
  3   2    7  PITOT-HEAT-SWITCH
  1  2      13.250
  3   3   12  HSI-HEADING-SET-KNOB
  1  2      13.250
  3   3   13  HSI-COURSE-SET-KNOB
  1  2      12.500
  3   3   14  MASTER-CAUTION
  1  2      13.500
  3   4   15  UHF-COMMAND-RADIO-CONTROL-MAIN
```

```
1  2      14.750
3   4   16  TACAN-CONTROL-CHANNEL-KNOB
1  2       4.500
3   4   17  RUDDER-PEDAL-ADJUST-T-HANDLE
1  2      16.000
3   4   18  CIRCUIT-BREAKER-LWR-CTR
1  2      18.125
3   5   19  FUEL-OXYGEN-CHECK-SWITCH
1  2      15.125
3   5   20  CANOPY-JETTISON-T-HANDLE
1  2      14.125
3   5   21  GENERATOR-SWITCH-LEFT
1  2      15.750
3   6   22  OXYGEN-SUPPLY-SWITCH-EMERGENCY
1  2      14.375
3   6   23  IFF-CONTROL-MASTER-KNOB
1  2      11.875
3   6   24  LIGHTING-CONTROL-EXTERIOR
1  2       5.750
3  11   25  CONTROL-STICK-NEUTRAL
1  2       3.625
3  11   26  CONTROL-STICK-FULL-FWD-LEFT
1  2      10.875
3  12   27  SEAT-ADJUST-SWITCH
1  2      12.000
3  12   29  EJECTION-HAND-GRIPS
1  2       0.000
3   1    1  THROTTLE-FWD
2  1       6.750
3   2    2  FUEL-SHUTOFF-SWITCH-LEFT
2  1      11.750
3   2    3  ENGINE-START-BUTTON-LEFT
2  1      11.625
3   2    4  LANDING-GEAR-ALT-REL-HANDLE
2  1       8.000
3   2    5  RADIO-TRANSFER-SWITCH-NAV
2  1       8.875
3   2    6  INTERCOMM-SWITCH-ILS
2  1       8.625
3   2    7  PITOT-HEAT-SWITCH
2  1       9.750
3   3    8  LANDING-GEAR-LEVER
2  1       6.000
3   3    9  DOWNLOCK-OVERRIDE-BUTTON
2  1       7.500
3   3   10  AIRSPEED/MACH-INDICATOR
2  1       7.125
3   3   11  STEERING-MODE-SWITCH-NORM
2  1       6.875
3   3   12  HSI-HEADING-SET-KNOB
2  1       6.875
3   3   13  HSI-COURSE-SET-KNOB
2  1       7.250
3   3   14  MASTER-CAUTION
2  1       9.500
```

```
3   4   15  UHF-COMMAND-RADIO-CONTROL-MAIN
2  1       9.125
3   4   16  TACAN-CONTROL-CHANNEL-KNOB
2  1      10.000
3   4   17  RUDDER-PEDAL-ADJUST-T-HANDLE
2  1      11.000
3   4   18  CIRCUIT-BREAKER-LWR-CTR
2  1      13.250
3  12   28  INERTIA-REEL-LOCK-LEVER
2  1       7.625
3  12   29  EJECTION-HAND-GRIPS
2  1       0.000
3   2    7  PITOT-HEAT-SWITCH
2  2      10.375
3   3   12  HSI-HEADING-SET-KNOB
2  2      10.625
3   3   13  HSI-COURSE-SET-KNOB
2  2      10.125
3   3   14  MASTER-CAUTION
2  2      10.875
3   4   15  UHF-COMMAND-RADIO-CONTROL-MAIN
2  2      12.500
3   4   16  TACAN-CONTROL-CHANNEL-KNOB
2  2      12.375
3   4   17  RUDDER-PEDAL-ADJUST-T-HANDLE
2  2      13.500
3   4   18  CIRCUIT-BREAKER-LWR-CTR
2  2      15.500
3   5   19  FUEL-OXYGEN-CHECK-SWITCH
2  2      11.250
3   5   20  CANOPY-JETTISON-T-HANDLE
2  2      10.750
3   5   21  GENERATOR-SWITCH-LEFT
2  2      12.375
3   6   22  OXYGEN-SUPPLY-SWITCH-EMERGENCY
2  2      11.000
3   6   23  IFF-CONTROL-MASTER-KNOB
2  2       9.750
3   6   24  LIGHTING-CONTROL-EXTERIOR
2  2       0.000
3  11   25  CONTROL-STICK-NEUTRAL
2  2       1.375
3  11   26  CONTROL-STICK-FULL-FWD-LEFT
2  2       9.000
3  12   27  SEAT-ADJUST-SWITCH
2  2       9.000
3  12   29  EJECTION-HAND-GRIPS
2  2       0.000
-1  -1  -1
```

SAMPLE CINPUT AIRCRAFT SCRIPT

```
Falcon> RUN CINPUT

     Data will be accepted in upper or lower case

     What type of data would you like to enter?

     Enter "A" for aircraft data or "S" for subject data: A

     Aircraft Name: T-38A

     Aircraft category:

     F(ighter), C(argo), T(rainer): T

     Enter Crewstation, <cr> when done

     F(orward), A(ft), L(eft), R(ight): F

     CREWSTATION SELECTED: FORWARD

     Is this control region applicable? Y(es) or N(o)

     LEFT-SIDE-PANEL                 : Y
     LEFT-AUXILIARY-PANEL            : Y
     MAIN-INSTRUMENT-PANEL           : Y
     CENTER-PEDESTAL                 : Y
     RIGHT-AUXILIARY-PANEL           : Y
     RIGHT-SIDE-PANEL                : Y
     OVERHEAD-CONTROL-PANEL          : N
     LEFT-BULKHEAD                   : N
     RIGHT-BULKHEAD                  : N
     GLARE-SHIELD                    : N
     CONTROL-STICK                   : Y
     SEAT                            : Y

     Seat Adjustment Data
     Each Direction will be Processed Separately

     V(ertical), H(orizontal), T(ilt Seat): V

     SEAT DIRECTION: VERTICAL

     Select Type of Adjustment for this Direction:

     C(ontinuous) or N(otched): C

     Enter Increment for One Seat Adjustment: .1

     Enter Seat Travel in inches from Full-up to Full-down: 4.8

     Seat Adjustment Data
     Each Direction will be Processed Separately

     V(ertical), H(orizontal), T(ilt Seat):

     Enter Crewstation, <cr> when done
```

```
Enter control data for:

CREWSTATION: FORWARD    REGION: LEFT-SIDE-PANEL
Control Names are 60 chars max, use dashes as delimiters

Control Name: THROTTLE-FWD

G(rip), F(inger), H(ook), T(humb): H

R(ight), L(eft), B(oth): L

CREWSTATION: FORWARD    REGION: LEFT-SIDE-PANEL
Control Names are 60 chars max, use dashes as delimiters

Control Name:

Enter control data for:

CREWSTATION: FORWARD    REGION: LEFT-AUXILIARY-PANEL
Control Names are 60 chars max, use dashes as delimiters

Control Name: FUEL-SHUTOFF-SWITCH-LEFT

G(rip), F(inger), H(ook), T(humb): F

R(ight), L(eft), B(oth): L

CREWSTATION: FORWARD    REGION: LEFT-AUXILIARY-PANEL
Control Names are 60 chars max, use dashes as delimiters

Control Name: ENGINE-START-BUTTON-LEFT

G(rip), F(inger), H(ook), T(humb): F

R(ight), L(eft), B(oth): L

CREWSTATION: FORWARD    REGION: LEFT-AUXILIARY-PANEL
Control Names are 60 chars max, use dashes as delimiters

Control Name:

Enter control data for:

CREWSTATION: FORWARD    REGION: MAIN-INSTRUMENT-PANEL
Control Names are 60 chars max, use dashes as delimiters

Control Name: LANDING-GEAR-LEVER

G(rip), F(inger), H(ook), T(humb): F

R(ight), L(eft), B(oth): L

CREWSTATION: FORWARD    REGION: MAIN-INSTRUMENT-PANEL
Control Names are 60 chars max, use dashes as delimiters

Control Name:

Enter control data for:

CREWSTATION: FORWARD    REGION: CENTER-PEDESTAL
Control Names are 60 chars max, use dashes as delimiters

Control Name: UHF-COMMAND-RADIO-CONTROL-MAIN

G(rip), F(inger), H(ook), T(humb): T
```

```
R(ight), L(eft), B(oth): B

CREWSTATION: FORWARD    REGION: CENTER-PEDESTAL
Control Names are 60 chars max, use dashes as delimiters

Control Name:

Enter control data for:

CREWSTATION: FORWARD    REGION: RIGHT-AUXILIARY-PANEL
Control Names are 60 chars max, use dashes as delimiters

Control Name: FUEL-OXYGEN-CHECK-SWITCH

G(rip), F(inger), H(ook), T(humb): H

R(ight), L(eft), B(oth): R

CREWSTATION: FORWARD    REGION: RIGHT-AUXILIARY-PANEL
Control Names are 60 chars max, use dashes as delimiters

Control Name: CANOPY-JETTISON-T-HANDLE

G(rip), F(inger), H(ook), T(humb): H

R(ight), L(eft), B(oth): R

CREWSTATION: FORWARD    REGION: RIGHT-AUXILIARY-PANEL
Control Names are 60 chars max, use dashes as delimiters

Control Name:

Enter control data for:

CREWSTATION: FORWARD    REGION: RIGHT-SIDE-PANEL
Control Names are 60 chars max, use dashes as delimiters

Control Name: OXYGEN-SUPPLY-SWITCH-EMERGENCY

G(rip), F(inger), H(ook), T(humb): F

R(ight), L(eft), B(oth): R

CREWSTATION: FORWARD    REGION: RIGHT-SIDE-PANEL
Control Names are 60 chars max, use dashes as delimiters

Control Name:

Enter control data for:

CREWSTATION: FORWARD    REGION: CONTROL-STICK
Control Names are 60 chars max, use dashes as delimiters

Control Name: CONTROL-STICK-NEUTRAL

G(rip), F(inger), H(ook), T(humb): G

R(ight), L(eft), B(oth): R

CREWSTATION: FORWARD    REGION: CONTROL-STICK
Control Names are 60 chars max, use dashes as delimiters

Control Name: CONTROL-STICK-FULL-FWD-LEFT

G(rip), F(inger), H(ook), T(humb): G
```

```
R(ight), L(eft), B(oth): R

CREWSTATION: FORWARD    REGION: CONTROL-STICK
Control Names are 60 chars max, use dashes as delimiters

Control Name:

Enter control data for:

CREWSTATION: FORWARD    REGION: SEAT
Control Names are 60 chars max, use dashes as delimiters

Control Name: SEAT-ADJUST-SWITCH

G(rip), F(inger), H(ook), T(humb): F

R(ight), L(eft), B(oth): R

CREWSTATION: FORWARD    REGION: SEAT
Control Names are 60 chars max, use dashes as delimiters

Control Name:

***Exiting Cockpit Input Program***
```

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APPENDIX H

VALIDATING COMPUTERIZED HUMAN ANALOGUES USED TO PREDICT COCKPIT ACCOMMODATION

VALIDATING COMPUTERIZED HUMAN ANALOGUES USED TO PREDICT COCKPIT ACCOMMODATION

To evaluate the ability of computer models to predict accommodation of the human operator in a crew or work station, it is necessary to utilize empirical data as a baseline against which the model can be validated. This report contains data which can be used for this purpose. The validation data used here were not gathered specifically for testing computer models, but to directly examine body size accommodation in aircraft, using human subjects, to develop a computerized aircraft accommodation database. If the computer model is intended to be a cockpit design and evaluation tool, comparisons between its predictions of cockpit accommodation, raw data taken from subjects, and smoothed data from the accommodation database should provide the basis for validating the accuracy of the computer model.

Several types of accommodation data are included in this report: actual subject data measured in an F-16A, data predicted from regression equations and average values from the F-16 study, and data derived using the COMBIMAN computer method. The regression and average values were taken from the Cockpit Accommodation Database.

The COMBIMAN can be assessed by entering the anthropometric data obtained from the test subjects used in the empirical study and comparing the computer model predictions to both the subjects' raw data, and the "smoothed data" that the database generates via regression analysis. It will be noticed that the raw data and regression data are somewhat different. The computer model can yield yet a third set of values. The extent to which the model data compare with the database data is a measure of how well the model represents the operator.

Measurements of body size accommodation in cockpits can be quite variable for subjects of similar size and sometimes difficult to repeat accurately on the same subject. There are a number of reasons for this, including variability in posture, restraint harness location or fit, protective equipment fit and effect on body mobility, and others. For these reasons, it is imperative that differences in results be looked at generally, and not examined down to a few tenths of an inch, or one or two degrees of visual angle.

In gathering the data in the cockpit, a number of assumptions concerning body posture must be made which will need to be mimicked by the computer model. We do not claim that these postures are typically assumed by pilots. An example is the frequent requirement that the subject hold his/her head in the Frankfort Plane. They are attempts to bring repeatability into this highly variable environment.

Data are included which describe reach to controls (with the inertial reels locked), vision out of the aircraft, ability to achieve full rudder throw, overhead clearance, and operational and ejection knee and leg clearance with the instrument panel and glareshield. Data were gathered on each of 10 small subjects and 5 large subjects. Their anthropometric measurements are listed in Tables 1 and 2. Anthropometric descriptions are given in Appendix A. Small subjects were used to obtain data on hand reach to controls, rudder pedal actuation, and vision out of the cockpit. Large subjects were used to obtain data on overhead clearance when the seat is full down and operational and ejection leg and knee clearances,

Accommodation data based on multivariate models are included in Appendix B. These models were developed to guide the anthropometric input into COMBIMAN.

TABLE 1

F-16A Anthropometric Data: F-16A Accommodation Subject Panel - Small Subjects
(Weight in lbs; all other values in inches)

	SUBJECTS									
	1	2	3	4	5	6	7	8	9	10
WEIGHT	124	132*	127*	117	120	136*	167	107	120	114
SITTING HEIGHT	33.9	34.4	33.6	33.5	34.1	35.0	35.0	33.7	32.9	33.6
SHOULDER HT., SITTING	22.1	22.2	22.1	21.6	22.3	23.5	23.3	21.9	19.9	21.1
KNEE HEIGHT, SITTING	19.2	19.4	19.3	18.7	20.0	19.7	20.7	19.6	19.2	18.6
BUTTOCK-KNEE LENGTH	21.9	22.0	22.0	21.5	22.5	23.1	23.0	22.3	21.9	20.5
SHOULDER-ELBOW LGTH	12.4	-	-	12.4	13.6	-	13.6	12.0	12.3	11.6
BIACROMIAL BREADTH	14.9	-	-	13.3	14.3	-	15.8	14.2	14.2	13.3
HIP BREADTH, SITTING	14.8	-	-	14.0	15.0	-	14.8	13.0	14.4	14.1
CHEST DEPTH	8.7	-	-	9.2	8.6	-	10.1	7.3	8.2	8.4
FOOT LENGTH	9.1	-	-	8.7	8.9	-	9.9	8.7	9.1	8.5
HAND LENGTH	6.8			6.1	6.8		7.0	6.3	6.3	6.2
ELBOW-WRIST LENGTH	10.1	-	-	9.7	10.8	-	11.1	9.0	10.0	10.3
THUMB-TIP REACH (L)	29.2	28.2	27.4	26.4	29.0	30.4	30.0	26.9	27.9	26.8
THUMB-TIP REACH (R)	27.8	28.3	27.5	26.3	29.0	30.4	30.6	27.4	27.7	26.8
EYE HEIGHT, SITTING	29.6	30.1	29.6	29.1	29.9	31.0	30.7	29.4	28.9	28.9*

* Values derived using regression equations. Subjects 2, 3, and 6 were not available for complete measurement.

TABLE 2

F-16A Accommodation Subject Panel - Anthropometric Data - Large Subjects (Weight in lbs; all other values in inches)

	1	2	3	4	5
WEIGHT	167	210	192	255	190
SITTING HEIGHT	37.9	39.4	38.7	41.0	37.1
ACROMION HT., SITTING	24.9	26.0	25.5	27.2	24.3
KNEE HEIGHT, SITTING	23.8	24.6*	23.3	25.3	21.5
BUTTOCK-KNEE LENGTH	26.7	27.4	25.8	27.0	24.5
SHOULDER-ELBOW LGTH*	15.4	15.7	15.0	15.6	14.4
BIACROMIAL BREADTH*	16.3	16.6	16.5	16.9	16.1
HIP BREADTH, SITTING*	15.0	15.3	14.6	15.1	14.2
CHEST DEPTH*	10.5	10.7	10.2	10.6	9.9
FOOT LENGTH*	11.3	11.5	11.1	11.8	10.5
HAND LENGTH*	8.0	8.1	7.8	8.1	7.6
ELBOW-WRIST LENGTH*	12.6	13.0	12.4	13.3	11.6
THUMB-TIP REACH*	34.2	34.8	33.4	31.8	32.3
EYE HEIGHT, SITTING	33.2	34.6	34.1	35.7*	32.2*

* Values derived from regression equations. Weight is reported in pounds: Other dimensions in inches.

Tables 3 through 9 list measures of accommodation in the cockpit of the F-16A. Raw data taken from subjects as well as the smoothed data from the database are represented. Subjects wore representative flight gear, including flight suits, boots, G-suit, survival vest, and parachute harness. Helmets and oxygen masks were not worn. Blanks are reserved for the inclusion of COMBIMAN data.

Measurements describing visual angles achieved by subjects looking (1) over the nose with the head in the Frankfort plane, (2) over the nose with the head and neck stretched upward and aft, and (3) over the side at the intersection of the glareshield and canopy are listed in Table 3. These data were used in regression equations to determine the vision algorithms for the Cockpit Accommodation Database. The database predictions for these visual angles are also listed in Table 3.

Table 4 lists measurements made to the farthest forward rudder carriage position that subjects could reach while keeping their heels on the rudder bar and applying full rudder and brake. The subjects' restraint harnesses were snugged down and their hips were not permitted to rotate in order to obtain greater leg reach. These measurements were used to determine the shortest leg length possible for operating the rudders in this fashion. For the F-16A (with the seat adjusted full up) that value is 38.4 inches (Buttock-Knee Length + Knee Height Sitting). In the F-16A, a subject with a one-inch-longer leg would not necessarily adjust the rudder carriage one inch further forward. In some aircraft this is true, but in the F-16A, the seat pan is angled rather sharply upward relative to the deck and the knee cannot be fully extended while the foot is on the rudder. Therefore, the database predicted values merely state how much additional leg length the subject has - not the subject's rudder carriage adjust position.

Subjects' reach miss distances to selected controls are listed in Tables 5 and 6. These measurements are taken by locking the subject's restraint system, snugging it down, and then having the subject reach toward a control. No significant fore or aft movement of the shoulders is permitted. A single number is given for the calculation of Zone 2 values. This represents the average amount of "stretch" that the restraint harness will allow when reaching into the various areas of the instrument panels. The values were arrived at by averaging the differences between Zone 1 and 2 values across all subjects for limited regions of the instrument panels. For example, the Fire/Overheat Detect control is on the aft portion of the Left Side Console. To reach it the pilot reaches downward. Only an additional 2.2 inches can be gained by stretching in this direction. On the other hand, to reach the Master Caution, which is on the glareshield forward of the left shoulder, 4.3 inches of additional reach can be obtained for Zone 2. Again, database values listed on the table are derived from regression equations and are "smoothed" predictions of reach capability for a person of that size.

Clearance between the helmet and the underside of the canopy in the F-16A is presented in Table 7. Data are obtained by measuring the distance between the top of the bare head and the underside of the canopy with the seat either full up or raised until the head touches the canopy. Maximum Sitting Height accommodated is calculated by adding the subject's Sitting Height, the amount of remaining downward seat adjustment and the space above the head. One and one half inches has been allowed for the additional height due to the helmet. No allowance has been made for free space above the helmet.

TABLE 3

F-16A Vision from the Cockpit - in Degrees - <u>Seat Full Up</u>

SUBJECTS	1	2	3	4	5	6	7	8	9	AVERAGES
EYE HT SIT	29.6	30.1	29.6	29.1	29.9	31.0	30.7	29.4	28.9	29.8
SUBJECT DATA										
FrPl O'Nose	-13	-13	-12	-11	-15	*	-16	-12	-12	-13
Head Up/Aft	-14	-15	-13	-15	-17	*	-19	-15	-13	-15
Over Side	-26	-24	-25	-25	-26	*	-28	-25	-22	-26
DATABASE DATA										
FrPl O'Nose	-13	-14	-13	-11	-14	-17	-16	-12	-11	-13
Head Up/Aft	-15	-16	-15	-13	-16	-19	-18	-14	-13	-15
Over Side	-25	-26	-25	-23	-26	-29	-28	-24	-23	-25
COMBIMAN DATA										
FrPl O'Nose										
Head Up/Aft										
Over Side										

* Data that, for various reasons, was not measured or provided.

TABLE 4

F-16A Rudder Pedal Access - Inches of Excess Leg Length Beyond that Needed to Actuate Rudder Pedals in Full Aft Carrigae Position

SUBJECTS	1	2	3	4	5	6	7	8	9	10	AVERAGES
BUTT KNEE L.	21.9	22.0	22.0	21.5	22.5	23.1	23.0	22.3	21.9	20.5	22.1
KNEE HT, SIT	19.2	19.4	19.3	18.7	20.0	19.7	20.7	19.6	19.2	18.6	19.4
COMBINED LEG	41.1	41.4	41.3	40.2	42.5	42.8	43.7	41.9	41.1	39.1	41.5
<u>SEAT FULL UP</u>											
SUBJECT RUDDER CARRIAGE ADJ. POSITION	1.50	2.50	2.50	0.75	1.75	2.75	2.50	1.00	1.63	-0.25	1.66
DATABASE EXCESS LEG LENGTH	2.70	3.00	2.90	1.80	4.10	4.40	5.30	3.50	2.70	0.70	3.11
COMBIMAN EXCESS LEG LENGTH											
<u>SEAT FULL DOWN</u>											
SUBJECT RUDDER CARRIAGE ADJ. POSITION	5.75	-	6.75	5.75	6.63	7.25	6.75	5.00	5.88	3.25	5.89
DATABASE EXCESS LEG LENGTH	7.00	7.30	7.20	6.10	8.40	8.70	9.60	7.80	7.00	5.00	7.40
COMBIMAN EXCESS LEG LENGTH											

* Subject's anthropometric data can be found in Table 1.

TABLE 5

F-16A <u>Left</u> Hand Reaches, Zones 1 and 2 - Individual Subject, Accommodation Database and COMBIMAN

ALL SUBJECTS WERE IN THE FULL-UP SEAT ADJUSTMENT
ANTHROPOMETRIC DATA ARE REPORTED IN TABLE 1.

SUBJECTS		9	10	4	8	1	5	7	MEAN
SHLDR HT, SIT		19.9	21.1	21.6	21.9	22.1	22.3	23.3	21.7
TH-T REACH (L)		27.9	26.8	26.4	26.9	29.2	29.0	30.6	28.1
CONTROL & * (HAND INTERFACE)**		REACH MISS DISTANCES (IN INCHES)							
1. FIRE/OVERHEAT DETECT (F)									
SUBJECT DATA	ZONE 1	0.5	-1.0	-2.7	-0.2	-1.5	-0.2	2.0	-0.4
	ZONE 2			(Add +2.2 to all Zone 1 values)					
DATABASE	ZONE 1	0.6	-1.2	-1.9	-1.6	0.5	-0.5	1.0	-0.4
	ZONE 2	2.8	1.0	0.3	0.6	2.7	1.7	3.2	1.8
COMBIMAN	ZONE 1								
	ZONE 2								
2. ANTI-G TEST (F)									
SUBJECT DATA	ZONE 1	1.5	0.5	-0.7	1.9	0.4	1.8	+	0.9
	ZONE 2			(Add +2.2 to all Zone 1 values)					
DATABASE	ZONE 1	2.0	0.0	-0.7	-0.5	1.6	0.4	2.0	0.7
	ZONE 2	4.2	2.2	1.5	1.7	3.8	2.6	4.2	2.9
COMBIMAN	ZONE 1								
	ZONE 2								
3. RUDDER ARM (T)									
SUBJECT DATA	ZONE 1	0.8	0.1	-2.6	0.7	-0.6	-0.1	+	-0.3
	ZONE 2			(Add +2.2 to all Zone 1 values)					
DATABASE	ZONE 1	1.4	-0.7	-1.6	-1.3	0.7	-0.5	1.0	-0.1
	ZONE 2	3.6	1.5	0.6	0.9	2.9	1.7	3.2	2.1
COMBIMAN	ZONE 1								
	ZONE 2								

* + VALUES INDICATE EXCESSIVE REACH (REACH CAPABILITY BEYOND CONTROL).
  - VALUES INDICATE INSUFFICIENT REACH (REACH CAPABILITY SHORT OF CONTROL).

** HAND INTERFACE: The interface of the hand with the control: e.g., "F" for Finger, "G" for Grip, "T" for Thumb/Forefinger, and "H" for Hook.

\+ Controls too close to permit measurement. They, therefore, are easily reached.

TABLE 5 (cont'd)

F-16A Left Hand Reaches, Zones 1 and 2 - Individual Subject, Accommodation Database and COMBIMAN

ALL SUBJECTS WERE IN THE FULL-UP SEAT ADJUSTMENT.

		9	10	4	8	1	5	7	MEAN
SHLDR HT, SIT		19.9	21.1	21.6	21.9	22.1	22.3	23.3	21.7
TH-T REACH (L)		27.9	26.8	26.4	26.9	29.2	29.0	30.6	28.1
CONTROL & (HAND INTERFACE)		REACH MISS DISTANCES (IN INCHES)							
4. VIDEO SELECT (F)									
SUBJECT DATA	ZONE 1	4.1	3.3	2.3	4.7	3.4	++	+	3.6
	ZONE 2			(Add +2.2 to all Zone 1 values)					
DATABASE	ZONE 1	4.3	2.5	1.8	2.1	4.3	3.4	5.0	3.3
	ZONE 2	6.5	4.7	4.0	4.3	6.5	5.6	7.2	5.5
COMBIMAN	ZONE 1								
	ZONE 2								
5. AIR REFUEL Open/Close (F)									
SUBJECT DATA	ZONE 1	2.0	1.9	0.9	2.5	2,9	2.3	+	2.1
	ZONE 2			(Add +2.2 to all Zone 1 values)					
DATABASE	ZONE 1	2.8	1.2	0.6	1.0	3.2	2.5	4.1	2.2
	ZONE 2	5.0	3.4	2.8	3.2	5.4	4.7	6.3	4.4
COMBIMAN	ZONE 1								
	ZONE 2								
6. CANOPY JETTISON (T)									
SUBJECT DATA	ZONE 1	++	++	-2.3	-0.3	+	0.1	-0.4	-0.7
	ZONE 2			(Add +2.2 to all Zone 1 values)					
DATABASE	ZONE 1	2.1	-0.3	-1.3	-1.2	0.8	-0.8	0.7	0.0
	ZONE 2	4.3	1.9	0.9	1.0	3.0	1.4	2.9	2.2
COMBIMAN	ZONE 1								
	ZONE 2								

* + VALUES INDICATE EXCESSIVE REACH (REACH CAPABILITY BEYOND CONTROL).
- VALUES INDICATE INSUFFICIENT REACH (REACH CAPABILITY SHORT OF CONTROL).

** HAND INTERFACE: The interface of the hand with the control: e.g., "F" for Finger, "G" for Grip, "T" for Thumb/Forefinger, and "H" for Hook.

\+ Controls too close to permit measurement. They, therefore, are easily reached.

++ Data that, for various reasons, was not measured or provided.

TABLE 5 (cont'd)

F-16A Left Hand Reaches, Zones 1 and 2 - Individual Subject, Accommodation Database and COMBIMAN

ALL SUBJECTS WERE IN THE FULL-UP SEAT ADJUSTMENT.

		9	10	4	8	1	5	7	MEAN
SHLDR HT, SIT		19.9	21.1	21.6	21.9	22.1	22.3	23.3	21.7
TH-T REACH (L)		27.9	26.8	26.4	26.9	29.2	29.0	30.6	28.1
CONTROL & (HAND INTERFACE)**		REACH MISS DISTANCES (IN INCHES)*							
7. PITCH TRIM (F)									
SUBJECT DATA	ZONE 1	2.4	2.9	1.6	3.8	2.4	3.8	+	2.8
	ZONE 2	(Add +2.2 to all Zone 1 values)							
DATABASE	ZONE 1	3.6	2.0	1.4	1.8	4.0	3.3	4.9	3.0
	ZONE 2	5.8	4.2	3.6	4.0	6.2	5.5	7.1	5.2
COMBIMAN	ZONE 1								
	ZONE 2								
8. MAIN POWER (BATT) (T)									
SUBJECT DATA	ZONE 1	-0.3	-0.3	-1.1	0.0	0.4	0.7	0.5	-0.0
	ZONE 2	(Add +2.2 to all Zone 1 values)							
DATABASE	ZONE 1	0.9	-0.7	-1.4	-1.1	1.0	0.2	1.8	0.1
	ZONE 2	3.1	1.5	0.8	1.1	3.2	2.4	4.0	2.3
COMBIMAN	ZONE 1								
	ZONE 2								
9. THROTTLE Fwd (H)									
SUBJECT DATA	ZONE 1	-1.9	-2.9	-4.0	-2.3	-0.9	-0.3	-0.8	-1.9
	ZONE 2	(Add +3.6 to all Zone 1 values)							
DATABASE	ZONE 1	-1.3	-2.8	-3.4	-3.0	-0.8	-1.4	0.1	-1.8
	ZONE 2	2.3	0.8	0.2	0.6	2.8	2.2	3.7	1.8
COMBIMAN	ZONE 1								
	ZONE 2								

* + VALUES INDICATE EXCESSIVE REACH (REACH CAPABILITY BEYOND CONTROL).
  - VALUES INDICATE INSUFFICIENT REACH (REACH CAPABILITY SHORT OF CONTROL).

** HAND INTERFACE: The interface of the hand with the control: e.g., "F" for Finger, "G" for Grip, "T" for Thumb/Forefinger, and "H" for Hook.

\+ Controls too close to permit measurement. They, therefore, are easily reached.

++ Data that, for various reasons, was not measured or provided.

TABLE 5 (cont'd)

F-16A <u>Left</u> Hand Reaches, Zones 1 and 2 - Individual Subject, Accommodation Database and COMBIMAN

ALL SUBJECTS WERE IN THE FULL-UP SEAT ADJUSTMENT.

		9	10	4	8	1	5	7	MEAN
SHLDR HT, SIT		19.9	21.1	21.6	21.9	22.1	22.3	23.3	21.7
TH-T REACH (L)		27.9	26.8	26.4	26.9	29.2	29.0	30.6	28.1
CONTROL & (HAND INTERFACE)**		REACH MISS DISTANCES (IN INCHES)*							
10. EEC Off/Buc (F)									
SUBJECT DATA	ZONE 1	-0.9	-1.5	-2.7	-1.3	0.4	0.3	1.1	-0.7
	ZONE 2	(Add +3.6 to all Zone 1 values)							
DATABASE	ZONE 1	-0.3	-1.6	-2.1	-1.7	0.5	0.0	1.6	-0.5
	ZONE 2	3.3	2.0	1.5	1.9	4.1	3.6	5.2	3.1
COMBIMAN	ZONE 1								
	ZONE 2								
11. UHF PRESET									
SUBJECT DATA	ZONE 1	-1.2	-0.9	-2.8	-0.3	0.0	0.3	0.0	-0.7
	ZONE 2	(Add +3.6 to all Zone 1 values)							
DATABASE	ZONE 1	0.0	-1.5	-2.1	-1.7	0.4	-0.2	1.3	-0.5
	ZONE 2	3.6	2.1	1.5	1.9	4.0	3.4	4.9	3.1
COMBIMAN	ZONE 1								
	ZONE 2								
12. JET FUEL START #2 (T)									
SUBJECT DATA	ZONE 1	-3.2	-3.9	-5.5	-3.5	-2.6	-2.7	-1.6	-3.3
	ZONE 2	(Add +3.6 to all Zone 1 values)							
DATABASE	ZONE 1	-2.5	-4.1	-4.7	-4.3	-2.0	-2.7	-1.1	-3.1
	ZONE 2	1.1	-0.5	-1.1	-0.7	1.6	0.9	2.5	0.5
COMBIMAN	ZONE 1								
	ZONE 2								

* + VALUES INDICATE EXCESSIVE REACH (REACH CAPABILITY BEYOND CONTROL).
  - VALUES INDICATE INSUFFICIENT REACH (REACH CAPABILITY SHORT OF CONTROL).
** HAND INTERFACE: The interface of the hand with the control: e.g., "F" for Finger, "G" for Grip, "T" for Thumb/Forefinger, and "H" for Hook.
\+ Controls too close to permit measurement. They, therefore, are easily reached.
++ Data that, for various reasons, was not measured or provided.

TABLE 5 (cont'd)

F-16A Left Hand Reaches, Zones 1 and 2 - Individual Subject, Accommodation Database and COMBIMAN

ALL SUBJECTS WERE IN THE FULL-UP SEAT ADJUSTMENT.

		9	10	4	8	1	5	7	MEAN
SHLDR HT, SIT		19.9	21.1	21.6	21.9	22.1	22.3	23.3	21.7
TH-T REACH (L)		27.9	26.8	26.4	26.9	29.2	29.0	30.6	28.1
CONTROL & (HAND INTERFACE)**		REACH MISS DISTANCES (IN INCHES)*							
13. RADAR L-BAR (F)									
SUBJECT DATA	ZONE 1	-2.0	-3.0	-3.9	-2.8	-1.0	-1.2	-0.6	-2.1
	ZONE 2	(Add +3.6 to all Zone 1 values)							
DATABASE	ZONE 1	-1.7	-3.1	-3.7	-3.2	-1.0	-1.5	0.0	-2.0
	ZONE 2	1.9	0.5	-0.1	0.4	2.6	2.1	3.6	1.6
COMBIMAN	ZONE 1								
	ZONE 2								
14. MANUAL PITCH OVERRIDE (F)									
SUBJECT DATA	ZONE 1	-3.3	-3.8	-4.5	-3.6	-1.5	-2.0	-0.8	-2.8
	ZONE 2	(Add +3.6 to all Zone 1 values)							
DATABASE	ZONE 1	-2.6	-3.9	-4.4	-4.0	-1.7	-2.1	-0.5	-2.7
	ZONE 2	1.0	-0.3	-0.8	-0.4	1.9	1.5	3.1	0.9
COMBIMAN	ZONE 1								
	ZONE 2								
15. STORAGE CONFIG CAT 1 (F)									
SUBJECT DATA	ZONE 1	-4.0	-4.7	-5.5	-4.3	-1.7	-2.5	-1.1	-3.4
	ZONE 2	(Add +3.6 to all Zone 1 values)							
DATABASE	ZONE 1	-3.4	-4.5	-4.9	-4.5	-2.2	-2.4	-0.8	-3.2
	ZONE 2	0.2	-0.9	-1.3	-0.9	1.4	1.2	2.8	0.4
COMBIMAN	ZONE 1								
	ZONE 2								

* + VALUES INDICATE EXCESSIVE REACH (REACH CAPABILITY BEYOND CONTROL).
- VALUES INDICATE INSUFFICIENT REACH (REACH CAPABILITY SHORT OF CONTROL).

** HAND INTERFACE: The interface of the hand with the control: e.g., "F" for Finger, "G" for Grip, "T" for Thumb/Forefinger, and "H" for Hook.

\+ Controls too close to permit measurement. They, therefore, are easily reached.

++ Data that, for various reasons, was not measured or provided.

TABLE 5 (cont'd)

F-16A Left Hand Reaches, Zones 1 and 2 - Individual Subject, Accommodation Database and COMBIMAN

ALL SUBJECTS WERE IN THE FULL-UP SEAT ADJUSTMENT.

		9	10	4	8	1	5	7	MEAN
SHLDR HT, SIT		19.9	21.1	21.6	21.9	22.1	22.3	23.3	21.7
TH-T REACH (L)		27.9	26.8	26.4	26.9	29.2	29.0	30.6	28.1
CONTROL & (HAND INTERFACE)**		REACH MISS DISTANCES (IN INCHES)*							
16. DOWNLOCK RELEASE (F)									
SUBJECT DATA	ZONE 1	-4.3	-4.6	-5.3	-4.2	-1.6	-1.8	-0.8	-3.2
	ZONE 2			(Add +3.6 to all Zone 1 values)					
DATABASE	ZONE 1	-3.6	-4.5	-4.9	-4.3	-2.0	-2.1	-0.5	-3.1
	ZONE 2	0.0	-0.9	-1.3	-0.7	1.6	1.5	3.1	0.5
COMBIMAN	ZONE 1								
	ZONE 2								
17. EMERGENCY STORES JETTISON (F)									
SUBJECT DATA	ZONE 1	-5.8	-6.7	-7.2	-6.1	-3.2	-2.8	-2.3	-4.9
	ZONE 2			(Add +3.6 to all Zone 1 values)					
DATABASE	ZONE 1	-5.5	-6.3	-6.6	-6.0	-3.6	-3.5	-1.9	-4.8
	ZONE 2	-1.9	-2.7	-3.0	-2.4	0.0	0.1	1.7	-1.2
COMBIMAN	ZONE 1								
	ZONE 2								
18. PITCH ALT HOLD (F)									
SUBJECT DATA	ZONE 1	-5.7	-6.3	-7.2	-6.2	-2.9	-3.5	-2.5	-4.9
	ZONE 2			(Add +3.6 to all Zone 1 values)					
DATABASE	ZONE 1	-5.2	-6.2	-6.5	-6.0	-3.7	-3.8	-2.2	-4.8
	ZONE 2	-1.6	-2.6	-2.9	-2.4	-0.1	-0.2	1.4	-1.2
COMBIMAN	ZONE 1								
	ZONE 2	++	++	OK	OK	OK	OK	OK	

* + VALUES INDICATE EXCESSIVE REACH (REACH CAPABILITY BEYOND CONTROL).
  - VALUES INDICATE INSUFFICIENT REACH (REACH CAPABILITY SHORT OF CONTROL).

** HAND INTERFACE: The interface of the hand with the control: e.g., "F" for Finger, "G" for Grip, "T" for Thumb/Forefinger, and "H" for Hook.

\+ Controls too close to permit measurement. They, therefore, are easily reached.

++ Data that, for various reasons, was not measured or provided.

TABLE 5 (cont'd)

F-16A <u>Left</u> Hand Reaches, Zones 1 and 2 - Individual Subject, Accommodation Database and COMBIMAN

ALL SUBJECTS WERE IN THE FULL-UP SEAT ADJUSTMENT.

		9	10	4	8	1	5	7	MEAN
SHLDR HT, SIT		19.9	21.1	21.6	21.9	22.1	22.3	23.3	21.7
TH-T REACH (L)		27.9	26.8	26.4	26.9	29.2	29.0	30.6	28.1
CONTROL & (HAND INTERFACE)**		REACH MISS DISTANCES (IN INCHES)*							
19. <u>IFF IDENT (F)</u>									
SUBJECT DATA	ZONE 1	-5.8	-7.0	-7.8	-7.1	-3.6	-3.6	-3.0	-5.4
	ZONE 2	(Add +3.6 to all Zone 1 values)							
DATABASE	ZONE 1	-5.7	-6.7	-7.0	-6.5	-4.2	-4.3	-2.7	-5.3
	ZONE 2	-2.1	-3.1	-3.4	-2.9	-0.6	-0.7	0.9	-1.7
COMBIMAN	ZONE 1								
	ZONE 2	++	OK	OK	OK	OK	OK	OK	
20. <u>MASTER CAUTION (F)</u>									
SUBJECT DATA	ZONE 1	++	++	-5.2	-4.3	++	-1.2	-0.4	-2.8
	ZONE 2	(Add +4.3 to all Zone 1 values)							
DATABASE	ZONE 1	-1.9	-3.6	-4.2	-3.9	-1.7	-2.5	-0.9	-2.7
	ZONE 2	2.4	0.7	0.1	0.4	2.6	1.8	3.4	1.6
COMBIMAN	ZONE 1								
	ZONE 2	++	OK	OK	OK	OK	OK	OK	
21. <u>DIS/LTS (T)</u>									
SUBJECT DATA	ZONE 1	-9.3	-9.8	-12.0	-9.9	-7.1	-7.4	-7.8	-9.0
	ZONE 2	(Add +4.3 to all Zone 1 values)							
DATABASE	ZONE 1	-8.1	-9.8	-10.4	-10.0	-7.8	-8.5	-6.9	-8.9
	ZONE 2	-3.8	-5.5	-6.1	-5.7	-3.5	-4.2	-2.6	-4.5
COMBIMAN	ZONE 1								
	ZONE 2	-2.2	-3.0	-3.0	-3.7	-2.0	-0.6	-1.5	-2.3

* + VALUES INDICATE EXCESSIVE REACH (REACH CAPABILITY BEYOND CONTROL).
  - VALUES INDICATE INSUFFICIENT REACH (REACH CAPABILITY SHORT OF CONTROL).

** HAND INTERFACE: The interface of the hand with the control: e.g., "F" for Finger, "G" for Grip, "T" for Thumb/Forefinger, and "H" for Hook.

\+ Controls too close to permit measurement. They, therefore, are easily reached.

++ Data that, for various reasons, was not measured or provided.

TABLE 5 (cont'd)

F-16A Left Hand Reaches, Zones 1 and 2 - Individual Subject, Accommodation Database and COMBIMAN

ALL SUBJECTS WERE IN THE FULL-UP SEAT ADJUSTMENT.

		9	10	4	8	1	5	7	MEAN
SHLDR HT, SIT		19.9	21.1	21.6	21.9	22.1	22.3	23.3	21.7
TH-T REACH (L)		27.9	26.8	26.4	26.9	29.2	29.0	30.6	28.1
CONTROL & (HAND INTERFACE)**		R E A C H M I S S D I S T A N C E S (I N I N C H E S)*							
22. SELECT JETTISON (F)									
SUBJECT DATA	ZONE 1	-9.0	-8.7	-9.9	-9.1	-5.9	-6.1	-6.5	-7.9
	ZONE 2	(Add +4.3 to all Zone 1 values)							
DATABASE	ZONE 1	-8.0	-9.1	-9.5	-9.0	-6.7	-6.9	-5.3	-7.8
	ZONE 2	-3.7	-4.8	-5.2	-4.7	-2.4	-2.6	-1.0	-3.5
COMBIMAN	ZONE 1								
	ZONE 2	++	-1.0	-1.0	-1.7	OK	OK	OK	
23. SHIFT (MFD) (F)									
SUBJECT DATA	ZONE 1	-8.1	-8.3	-9.3	-8.3	-5.1	-5.6	-6.4	-7.3
	ZONE 2	(Add +4.3 to all Zone 1 values)							
DATABASE	ZONE 1	-7.1	-8.4	-8.9	-8.5	-6.2	-6.6	-5.0	-7.2
	ZONE 2	-2.8	-4.1	-4.6	-4.2	-1.9	-2.3	-0.7	-2.9
COMBIMAN	ZONE 1								
	ZONE 2	++	-0.7	-0.7	-1.4	OK	OK	OK	
24. HUD FILTER (T)									
SUBJECT DATA	ZONE 1	-6.8	-5.9	-8.0	-6.1	-3.5	-3.6	-4.9	-5.5
	ZONE 2	(Add +4.3 to all Zone 1 values)							
DATABASE	ZONE 1	-5.6	-6.7	-7.1	-6.6	-4.3	-4.5	-2.9	-5.4
	ZONE 2	-1.3	-2.4	-2.8	-2.3	0.0	-0.2	1.4	-1.1
COMBIMAN	ZONE 1								
	ZONE 2	++	OK	++	++	OK	OK	OK	

* + VALUES INDICATE EXCESSIVE REACH (REACH CAPABILITY BEYOND CONTROL).
  - VALUES INDICATE INSUFFICIENT REACH (REACH CAPABILITY SHORT OF CONTROL).

** HAND INTERFACE: The interface of the hand with the control: e.g., "F" for Finger, "G" for Grip, "T" for Thumb/Forefinger, and "H" for Hook.

\+ Controls too close to permit measurement. They, therefore, are easily reached.

++ Data that, for various reasons, was not measured or provided.

TABLE 5 (cont'd)

F-16A Left Hand Reaches, Zones 1 and 2 - Individual Subject, Accommodation Database and COMBIMAN

ALL SUBJECTS WERE IN THE FULL-UP SEAT ADJUSTMENT.

		9	10	4	8	1	5	7	MEAN
SHLDR HT, SIT		19.9	21.1	21.6	21.9	22.1	22.3	23.3	21.7
TH-T REACH (L)		27.9	26.8	26.4	26.9	29.2	29.0	30.6	28.1
CONTROL & (HAND INTERFACE)**		REACH MISS DISTANCES (IN INCHES)*							
25. HUD MILS-DEPR (T)									
SUBJECT DATA	ZONE 1	-8.4	-7.0	-8.9	-7.0	-4.8	-4.7	-5.6	-6.6
	ZONE 2	(Add +4.3 to all Zone 1 values)							
DATABASE	ZONE 1	-7.8	-8.6	-8.9	-8.3	-5.9	-5.8	-4.2	-7.1
	ZONE 2	-3.5	-4.3	-4.6	-4.0	-1.6	-1.5	0.1	-2.8
COMBIMAN	ZONE 1								
	ZONE 2	OK	OK	OK	OK	OK	OK	OK	OK
26. AIR SPEED/MACH IND (T)									
SUBJECT DATA	ZONE 1	-10.2	-10.3	-11.8	-10.3	-7.3	-7.7	-8.0	-9.4
	ZONE 2	(Add +4.3 to all Zone 1 values)							
DATABASE	ZONE 1	-9.4	-10.6	-11.0	-10.5	-8.3	-8.6	-7.0	-9.3
	ZONE 2	-5.1	-6.3	-6.7	-6.2	-4.0	-4.3	-2.7	-5.0
COMBIMAN	ZONE 1								
	ZONE 2	-3.6	-4.3	-4.3	-5.2	-3.6	-2.1	-3.3	-3.8
27. TACAN HEADING (T)									
SUBJECT DATA	ZONE 1	-8.4	-7.9	-10.0	-8.5	-6.1	-6.2	-7.0	-7.7
	ZONE 2	(Add +4.3 to all Zone 1 values)							
DATABASE	ZONE 1	-7.3	-8.8	-9.3	-8.9	-6.7	-7.3	-5.7	-7.7
	ZONE 2	-3.0	-4.5	-5.0	-4.6	-2.4	-3.0	-1.4	-3.4
COMBIMAN	ZONE 1								
	ZONE 2	-2.7	-3.3	-3.4	-4.3	-2.7	-1.3	-2.5	-2.9

* + VALUES INDICATE EXCESSIVE REACH (REACH CAPABILITY BEYOND CONTROL).
  - VALUES INDICATE INSUFFICIENT REACH (REACH CAPABILITY SHORT OF CONTROL).

** HAND INTERFACE: The interface of the hand with the control: e.g., "F" for Finger, "G" for Grip, "T" for Thumb/Forefinger, and "H" for Hook.

\+ Controls too close to permit measurement. They, therefore, are easily reached.

++ Data that, for various reasons, was not measured or provided.

TABLE 5 (cont'd)

F-16A <u>Left</u> Hand Reaches, Zones 1 and 2 - Individual Subject, Accommodation Database and COMBIMAN

ALL SUBJECTS WERE IN THE FULL-UP SEAT ADJUSTMENT.

		9	10	4	8	1	5	7	MEAN
SHLDR HT, SIT		19.9	21.1	21.6	21.9	22.1	22.3	23.3	21.7
TH-T REACH (L)		27.9	26.8	26.4	26.9	29.2	29.0	30.6	28.1
CONTROL & (HAND INTERFACE)**		REACH MISS DISTANCES (IN INCHES)*							
28. COURSE SELECT (T)									
SUBJECT DATA	ZONE 1	-9.9	-9.5	-11.0	-9.9	-7.3	-7.9	-9.1	-9.2
	ZONE 2	(Add +4.3 to all Zone 1 values)							
DATABASE	ZONE 1	-8.6	-10.2	-10.7	-10.4	-8.1	-8.8	-7.2	-9.1
	ZONE 2	-4.3	-5.9	-6.4	-6.1	-3.8	-4.5	-2.9	-4.8
COMBIMAN	ZONE 1								
	ZONE 2	-3.8	-4.3	-4.4	-5.3	-3.8	-2.3	-3.6	-3.9
29. HSI Pull to Cage (T)									
SUBJECT DATA	ZONE 1	-12.0	-12.8	-14.4	-12.0	-9.7	-10.2	-11.0	-11.7
	ZONE 2	(Add +4.3 to all Zone 1 values)							
DATABASE	ZONE 1	-12.1	-13.1	-13.4	-12.9	-10.6	-10.7	-9.1	-11.7
	ZONE 2	-7.8	-8.8	-9.1	-8.6	-6.3	-6.4	-4.8	-7.4
COMBIMAN	ZONE 1								
	ZONE 2	-6.7	-7.2	-7.2	-8.1	-6.7	-5.0	-6.1	-6.7
30. ALTIMETER Select (F)									
SUBJECT DATA	ZONE 1	-11.5	-11.8	-12.3	-10.8	-8.6	-9.0	-9.3	-10.5
	ZONE 2	(Add +4.3 to all Zone 1 values)							
DATABASE	ZONE 1	-10.9	-11.6	-11.9	-11.3	-9.0	-8.8	-7.2	-10.1
	ZONE 2	-6.6	-7.3	-7.6	-7.0	-4.7	-4.5	-2.9	-5.8
COMBIMAN	ZONE 1								
	ZONE 2	-4.5	-5.0	-5.1	-6.0	-4.4	-2.8	-3.9	-4.5

* + VALUES INDICATE EXCESSIVE REACH (REACH CAPABILITY BEYOND CONTROL).
  - VALUES INDICATE INSUFFICIENT REACH (REACH CAPABILITY SHORT OF CONTROL).
** HAND INTERFACE: The interface of the hand with the control: e.g., "F" for Finger, "G" for Grip, "T" for Thumb/Forefinger, and "H" for Hook.
\+ Controls too close to permit measurement. They, therefore, are easily reached.
++ Data that, for various reasons, was not measured or provided.

TABLE 5 (cont'd)

F-16A Left Hand Reaches, Zones 1 and 2 - Individual Subject, Accommodation Database and COMBIMAN

ALL SUBJECTS WERE IN THE FULL-UP SEAT ADJUSTMENT.

		9	10	4	8	1	5	7	MEAN
SHLDR HT, SIT		19.9	21.1	21.6	21.9	22.1	22.3	23.3	21.7
TH-T REACH (L)		27.9	26.8	26.4	26.9	29.2	29.0	30.6	28.1
CONTROL & (HAND INTERFACE)**		REACH MISS DISTANCES (IN INCHES)*							
31. FUEL QUANT SELECT (T)									
SUBJECT DATA	ZONE 1	-15.4	-14.9	-17.1	-14.9	-14.0	-13.8	-15.1	-15.0
	ZONE 2	(Add +4.3 to all Zone 1 values)							
DATABASE	ZONE 1	-14.1	-15.8	-16.5	-16.1	-13.9	-14.7	-13.1	-14.9
	ZONE 2	-9.8	-11.5	-12.2	-11.8	-9.6	-10.4	-8.8	-10.6
COMBIMAN	ZONE 1								
	ZONE 2								

TABLE 6

F-16A <u>Right</u> Hand Reaches, Zones 1 and 2 - Individual Subject, Accommodation Database and COMBIMAN

ALL SUBJECTS WERE IN THE FULL-UP SEAT ADJUSTMENT.
ANTHROPOMETRIC DATA ARE REPORTED IN TABLE 1.

		9	10	4	8	1	5	7	MEAN
SHLDR HT, SIT		19.9	21.1	21.6	21.9	22.1	23.3	23.3	21.9
TH-T REACH (R)		27.9	26.8	26.4	27.4	27.8	29.0	30.0	27.9
CONTROL & * (HAND INTERFACE) **		REACH MISS DISTANCES (IN INCHES)							
31. FUEL QUANT SELECT (T)									
SUBJECT DATA	ZONE 1	-8.3	-7.7	-8.8	-7.2	-5.1	-4.0	-6.6	-6.8
	ZONE 2	(Add +2.3 to all Zone 1 values)							
DATABASE	ZONE 1	-6.9	-8.1	-8.5	-7.5	-7.1	-6.0	-5.0	-7.0
	ZONE 2	-4.6	-5.8	-6.2	-5.2	-4.8	-3.7	-2.7	-4.7
COMBIMAN	ZONE 1								
	ZONE 2								
32. CONTROL GRIP (G)									
SUBJECT DATA	ZONE 1	0.0	0.4	-0.3	-0.6	2.2	1.5	0.8	0.6
	ZONE 2	(Add +2.3 to all Zone 1 values)							
DATABASE	ZONE 1	1.6	-0.1	-0.8	0.0	0.2	0.7	1.7	0.5
	ZONE 2	3.9	2.2	1.5	2.3	2.5	3.0	4.0	2.8
COMBIMAN	ZONE 1								
	ZONE 2								
33. ILS VOL (T)									
SUBJECT DATA	ZONE 1	-3.9	-3.4	-4.5	-4.7	-2.2	-1.6	-2.6	-3.3
	ZONE 2	(Add +2.3 to all Zone 1 values)							
DATABASE	ZONE 1	-3.2	-4.6	-5.1	-4.2	-3.9	-3.0	-2.0	-3.7
	ZONE 2	-0.9	-2.3	-2.8	-1.9	-1.6	-0.7	0.3	-1.4
COMBIMAN	ZONE 1								
	ZONE 2								

* + VALUES INDICATE EXCESSIVE REACH (REACH CAPABILITY BEYOND CONTROL).
 - VALUES INDICATE INSUFFICIENT REACH (REACH CAPABILITY SHORT OF CONTROL).
** HAND INTERFACE: The interface of the hand with the control: e.g., "F" for Finger, "G" for Grip, "T" for Thumb/Forefinger, and "H" for Hook.

TABLE 6 (cont'd)

F-16A Right Hand Reaches, Zones 1 and 2 - Individual Subject, Accommodation Database and COMBIMAN

ALL SUBJECTS WERE IN THE FULL-UP SEAT ADJUSTMENT.

		9	10	4	8	1	5	7	MEAN
SHLDR HT, SIT		19.9	21.1	21.6	21.9	22.1	23.3	23.3	21.9
TH-T REACH (R)		27.9	26.8	26.4	27.4	27.8	29.0	30.0	27.9
CONTROL & (HAND INTERFACE)**		REACH MISS DISTANCES (IN INCHES)*							
34. FUEL QUANT SELECT (T)									
SUBJECT DATA	ZONE 1	-8.3	-7.7	-8.8	-7.2	-5.1	-4.0	-6.6	-6.8
	ZONE 2	(Add +2.3 to all Zone 1 values)							
DATABASE	ZONE 1	-6.9	-8.1	-8.5	-7.5	-7.1	-6.0	-5.0	-7.0
	ZONE 2	-4.6	-5.8	-6.2	-5.2	-4.8	-3.7	-2.7	-4.7
COMBIMAN	ZONE 1								
	ZONE 2								
35. CONTROL GRIP (G)									
SUBJECT DATA	ZONE 1	0.0	0.4	-0.3	-0.6	2.2	1.5	0.8	0.6
	ZONE 2	(Add +2.3 to all Zone 1 values)							
DATABASE	ZONE 1	1.6	-0.1	-0.8	0.0	0.2	0.7	1.7	0.5
	ZONE 2	3.9	2.2	1.5	2.3	2.5	3.0	4.0	2.8
COMBIMAN	ZONE 1								
	ZONE 2								
36. ILS VOL (T)									
SUBJECT DATA	ZONE 1	-3.9	-3.4	-4.5	-4.7	-2.2	-1.6	-2.6	-3.3
	ZONE 2	(Add +2.3 to all Zone 1 values)							
DATABASE	ZONE 1	-3.2	-4.6	-5.1	-4.2	-3.9	-3.0	-2.0	-3.7
	ZONE 2	-0.9	-2.3	-2.8	-1.9	-1.6	-0.7	0.3	-1.4
COMBIMAN	ZONE 1								
	ZONE 2								

* + VALUES INDICATE EXCESSIVE REACH (REACH CAPABILITY BEYOND CONTROL).
  - VALUES INDICATE INSUFFICIENT REACH (REACH CAPABILITY SHORT OF CONTROL).

** HAND INTERFACE: The interface of the hand with the control: e.g., "F" for Finger, "G" for Grip, "T" for Thumb/Forefinger, and "H" for Hook.

TABLE 6 (cont'd)

F-16A Right Hand Reaches, Zones 1 and 2 - Individual Subject, Accommodation Database and COMBIMAN

ALL SUBJECTS WERE IN THE FULL-UP SEAT ADJUSTMENT.

		9	10	4	8	1	5	7	MEAN
SHLDR HT, SIT		19.9	21.1	21.6	21.9	22.1	23.3	23.3	21.9
TH-T REACH (R)		27.9	26.8	26.4	27.4	27.8	29.0	30.0	27.9
CONTROL & (HAND INTERFACE)**		REACH MISS DISTANCES (IN INCHES)*							
37. SUIT PRESSURE (F)									
SUBJECT DATA	ZONE 1	-2.6	-1.7	-2.8	-2.5	-0.5	0.0	-0.2	-1.5
	ZONE 2			(Add +2.3 to all Zone 1 values)					
DATABASE	ZONE 1	-1.3	-2.6	-3.1	-2.1	-1.7	-0.7	0.2	-1.6
	ZONE 2	1.0	-0.3	-0.8	0.2	0.6	1.6	2.5	0.7
COMBIMAN	ZONE 1								
	ZONE 2								
38. MAL & IND LIGHTS (F)									
SUBJECT DATA	ZONE 1	1.8	0.9	0.2	1.2	2.1	2.4	2.6	1.6
	ZONE 2			(Add +2.3 to all Zone 1 values)					
DATABASE	ZONE 1	2.7	0.9	0.2	1.0	1.3	1.8	2.8	1.5
	ZONE 2	5.0	3.2	2.5	3.3	3.6	4.1	5.1	3.8
COMBIMAN	ZONE 1								
	ZONE 2								
39. AERIAL REFUEL LIGHTS (T)									
SUBJECT DATA	ZONE 1	3.4	2.7	0.9	2.4	2.6	3.1	+	2.2
	ZONE 2			(Add +2.3 to all Zone 1 values)					
DATABASE	ZONE 1	2.8	1.1	0.5	1.3	1.6	2.3	3.3	1.8
	ZONE 2	5.1	3.4	2.8	3.6	3.9	4.6	5.6	4.1
COMBIMAN	ZONE 1								
	ZONE 2								

* + VALUES INDICATE EXCESSIVE REACH (REACH CAPABILITY BEYOND CONTROL).
  - VALUES INDICATE INSUFFICIENT REACH (REACH CAPABILITY SHORT OF CONTROL).

** HAND INTERFACE: The interface of the hand with the control: e.g., "F" for Finger, "G" for Grip, "T" for Thumb/Forefinger, and "H" for Hook.

\+ Controls too close to permit measurement. They, therefore, are easily reached.

TABLE 6 (cont'd)

F-16A Right Hand Reaches, Zones 1 and 2 - Individual Subject, Accommodation Database and COMBIMAN

ALL SUBJECTS WERE IN THE FULL-UP SEAT ADJUSTMENT.

		9	10	4	8	1	5	7	MEAN
SHLDR HT, SIT		19.9	21.1	21.6	21.9	22.1	23.3	23.3	21.9
TH-T REACH (R)		27.9	26.8	26.4	27.4	27.8	29.0	30.0	27.9
CONTROL & (HAND INTERFACE)**		REACH MISS DISTANCES (IN INCHES)*							
40. ANTENNA SEL UHF (F)									
SUBJECT DATA	ZONE 1	3.2	2.0	1.6	2.8	3.1	3.9	+	2.8
	ZONE 2			(Add +2.3 to Zone 1 values)					
DATABASE	ZONE 1	3.4	1.8	1.2	2.1	2.4	3.1	4.1	2.6
	ZONE 2	5.7	4.1	3.5	4.4	4.7	5.4	6.4	4.9
COMBIMAN	ZONE 1								
	ZONE 2								
41. OXYGEN SUPPLY 100% Norm (F)									
SUBJECT DATA	ZONE 1	3.2	0.7	1.3	2.8	2.6	3.7	5.6	2.8
	ZONE 2			(Add +2.3 to Zone 1 values)					
DATABASE	ZONE 1	2.6	1.5	1.1	2.1	2.5	3.7	4.7	2.6
	ZONE 2	4.9	3.8	3.4	4.4	4.8	6.0	7.0	4.9
COMBIMAN	ZONE 1								
	ZONE 2								

* + VALUES INDICATE EXCESSIVE REACH (REACH CAPABILITY BEYOND CONTROL).
  - VALUES INDICATE INSUFFICIENT REACH (REACH CAPABILITY SHORT OF CONTROL).

** HAND INTERFACE: The interface of the hand with the control: e.g., "F" for Finger, "G" for Grip, "T" for Thumb/Forefinger, and "H" for Hook.

\+ Controls too close to permit measurement. They, therefore, are easily reached.

TABLE 7

F-16A Overhead Clearance Data, Seat Full Down - in Inches
(values in inches)

	SUBJECT DATA					
	1	5	4	3	6	Average
Sitting Height	37.9	37.1	41.0	38.7	38.0	38.5
Overhead Clearance	+5.6	+5.5	+1.5	+4.5	+5.0	+4.4
Less Helmet	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5
Maximum Sitting Ht. Accommodated	42.0	41.1	41.0	41.7	41.5	41.5
	DATABASE					
Sitting Height	37.9	37.1	41.0	38.7	38.0	38.5
Overhead Clearance (From Helmet)	+3.6	+4.4	+0.5	+2.8	+3.5	+3.0
Maximum Sitting Ht. Accommodated	41.5	41.5	41.5	41.5	41.5	41.5
	COMBIMAN					
Sitting Height	37.9	37.1	41.0	38.7	38.0	38.5
Overhead Clearance						
Less Helmet	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5
Maximum Sitting Ht. Accommodated						

Table 8 lists operational clearances between the leg and the main instrument panel in the F-16A. Measurements were made after the subject had adjusted the seat to his/her best flying position. The rudder pedal carriage is adjusted to the most forward position that permits the subject full forward throw and brake, with the knee comfortably, but fully extended, and without squirming either hip forward. The feet then engage the pedals in the neutral position. Clearances are measured between the leg (at the knee or shin) and the lower edge of the main instrument panel, and/or protruding controls and control guards.

Knee clearances with the glare shield are presented in Table 9. The thighs should be set at right angles to the ejection rails and the knees and feet are set 12 inches apart. A straight-edge is placed against the forward surface of the left knee in single cockpits and held in the vertical (X-Z) fore-aft plane. The top of a straight-edge is adjusted to an angle equal to that of the ejection rails. Clearance is measured perpendicular from the aft surface of the straight edge to the nearest non-frangible cockpit structure or other threatening surface or edge forward of the knees.

TABLE 8

F-16A Operational Shin Clearance with Main Instrument Panel
(values in inches)

SUBJECT DATA*	NA	NA	NA	NA	NA	NA	1	3	Averages
Buttock Knee Lth	26.1	26.0	25.8	26.4	27.4	26.7	26.7	25.8	26.4
Shin Clearance with MIP	.75	.5	.25	1.0	.125	.25	1.375	.625	.6
Maximum Buttock Knee L. Accommodated.	27.1	26.5	26.2	27.4	27.4	27.0	28.1	26.4	27.0
DATABASE									
Buttock Knee Lth	26.1	26.0	25.8	26.4	27.4	26.7	26.7	25.8	26.4
Shin Clearance with MIP	.7	1.0	1.1	.6	-.3	.3	.3	1.2	.6
Maximum Buttock Knee L. Accommodated.	26.8	27.0	26.8	27.0	27.1	27.0	27.0	27.0	27.0
COMBIMAN									
Buttock Knee Lth	26.1	26.0	25.8	26.4	27.4	26.7	26.7	25.8	26.4
Shin Clearance with MIP									
Maximum Buttock Knee L. Accommodated.									

* Subjects indicated by "NA" were from another program. Complete anthropometric data are not available.

TABLE 9

Clearance Between the Knees and the Glare Shield, F-16A
(values in inches)

SUBJECT DATA*	1	2	3	4	AVERAGES
Buttock-Knee Lgth.	26.7	27.4	25.8	27.0	26.7
CLEARANCE	3.5	2.8	2.4	-	2.9
Maximum Buttock-Knee Lgth. Accommodated	30.2	30.2	28.2	-	29.5
DATABASE					
Buttock-Knee Lgth.	26.7	27.4	25.8	27.0	26.7
CLEARANCE	2.8	2.1	3.7	2.5	2.8
Maximum Buttock-Knee Lgth. Accommodated	29.5	29.5	29.5	29.5	29.5
COMBIMAN					
Buttock-Knee Lgth.	26.7	27.4	25.8	27.0	26.7
CLEARANCE					
Maximum Buttock-Knee Lgth. Accommodated					

ANTHROPOMETRIC DESCRIPTIONS

BIACROMIAL BREADTH
Subject sits erect, head in the Frankfort plane, arms hanging relaxed, elbows flexed to about 90 degrees, and forearms and hands extended forward horizontally - the horizontal distance between the right and left Acromiale.

BUTTOCK-KNEE LENGTH
Subject sits erect, feet resting on a surface adjusted so that the knees are flexed to about right angles and thighs horizontal - the horizontal distance from the rearmost surface of the right buttock to the forward surface of the right kneecap.

CHEST DEPTH
Subject stands erect - the maximum horizontal depth of the torso at the level of the nipples during quiet breathing.

ELBOW-WRIST LENGTH
Subject stands erect (Typ), right arm hanging at the side, elbow flexed to 90 degrees, the forearm and hand extended forward horizontally, hand flattened - the distance from the tip of the right elbow to the wrist (Stylion).

FOOT LENGTH
Subject stands, weight equally distributed on both feet - the maximum length of the foot to the longest toe, parallel to the longitudinal axis of the foot.

FRANKFORT PLANE
A standard plane of reference of the head, realized when the lowest point of the bony margin of the eye socket (orbit) and the left tragion (top of the tragus or "flap" which forms the forward margin of the "ear hole") are in a common horizontal plane.

HAND LENGTH
Right hand extended, flattened, palm up, fingers extended and together - the distance from the proximal edge of the navicular bone in the wrist (USAF.MEN) or from the distal wrist crease (USAFLY.MEN, USAF.WOM and USAFLY.WOM) to the tip of the longest finger parallel to the long axis of the hand.

HIP BREADTH, SITTING
Subject sits, feet resting on a surface adjusted so that the knees are flexed to about 90 degrees and thighs are parallel - the horizontal distance across the widest part of the hips.

SHOULDER-ELBOW LENGTH
Subject sits erect, arms hanging relaxed at sides, elbow flexed to 90 degrees, forearms and hands directed forward horizontally - the vertical distance from the right Acromion (Acromiale) to the bottom of the elbow (olecranon process).

SHOULDER (ACROMION) HEIGHT, SITTING
Subject sits erect, head in the Frankfort plane, upper arms hanging relaxed at sides, and forearms and hands extended forward horizontally - the vertical distance from the sitting surface to the right Acromion - bony landmark at the tip of the shoulder.

SITTING EYE HEIGHT
Subject sits erect, head in the Frankfort plane, upper arms hanging relaxed, forearms and hands extended forward horizontally - the vertical distance from the sitting surface to the right external canthus (outer "corner").

SITTING HEIGHT

Subject sits erect, head in the Frankfort plane, upper arms hanging naturally at sides, elbows flexed to 90 degrees, forearms and hands directed forward - the vertical distance from the sitting surface to the top of the head.

SITTING KNEE HEIGHT

Subject sits with feet resting on a surface adjusted so that the thighs are horizontal and the knees are flexed to about 90 degrees - the vertical distance from the footrest surface to the superior margin of the right knee cap.

THUMB-TIP REACH

Subject stands erect with heels, buttocks, and back in contact with a wall or other vertical surface. The right arm is rotated forward to the horizontal, thumb and forefinger tips opposed in a finger-tip grasping attitude, thumb extended and parallel to the axis of the arm and forearm - the distance from the wall to the tip of the thumb.

WEIGHT

The subject is nude or wearing brief undergarments - read to the nearest pound.

MULTIVARIATE MODELS

Multivariate models, developed to guide the anthropometric input into COMBIMAN are shown in Table B-1. Usually eight models are used to represent a population and consist of six to eight body dimensions. COMBIMAN, however, requires 12 models and 12 body dimensions, because of the introduction of mass related anthropometric dimensions (breadths, depths, and weight) for the computer model. Some of the additional measurements necessary for representation with COMBIMAN were regressed from Sitting Height, Buttock-Knee Length, and Weight. Selection of these variables as regressors was based upon a principal components analysis. That analysis showed which of these three measurements received the highest factor loadings on each of the first three principal components.

Body size values for each of the multivariate models were run through the Cockpit Accommodation Database. Since the mass-related measurements are not required as input for the database, it was only necessarv to run the six models as originally defined (that is, without the lightweight / heavyweight distinctions). Data regarding accommodation of each model in the F-16A are reported in Tables B-2 through B-8.

Most of the values from the database are developed by regression equations based on subjects of various sizes. Others are mean values from a group of subjects selected to be near the "critical value". For example, subjects near 40 inches in Sitting Height were selected for measuring overhead clearance in the F-16A. Each subject's Sitting Height was added to the distance they adjusted the seat upwards to make contact with the canopy. Those values were averaged to determine the maximum Sitting Height that would fit into the aircraft when the seat was adjusted full down.

There is always some variance around the mean in measures such as these. Therefore, the results for the test cases can be interpreted as the "average" values for a group of individuals of that particular size. Some variation around the predicted values the database delivers are expected.

TABLE B-1: ANTHROPOMETRIC MULTIVARIATE MODELS WITH ADDITIONAL MEASURES FOR COMBIMAN.

	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5	MODEL 6
	GENERALIZED	GENERALIZED	SMALL FEMALE	SMALL FEMALE	MALE	MALE
	SMALL FEMALE LIGHT WEIGHT	SMALL FEMALE HEAVY WEIGHT	SHORT REACH HIGHER SHLDRS LIGHT WEIGHT	SHORT REACH HIGHER SHLDRS HEAVY WEIGHT	SHORT TORSO LONG LIMBS LIGHT WEIGHT	SHORT TORSO LONG LIMBS HEAVY WEIGHT
WEIGHT	103.0	138.0	110.0	135.0	145.0	197.0
SITTING HEIGHT	34.0	34.0	35.5	35.5	34.9	34.9
SITTING EYE HEIGHT	28.9	28.9	30.7	30.7	30.2	30.2
SITTING ACROMION HT	21.3	21.3	22.7	22.7	22.6	22.6
SITTING KNEE HEIGHT	19.5	19.5	19.1	19.1	23.3	23.3
THUMBTIP REACH	28.3	28.3	27.6	27.6	33.9	33.9
BUTTOCK-KNEE LENGTH	22.1	22.1	21.3	21.3	26.5	26.5
SHOULDER-ELBOW LGTH	13.0	12.9	12.8	12.7	15.5	15.4
BIACROMIAL BREADTH	14.5	14.9	14.6	15.0	15.4	16.0
HIP BREADTH, STANDING	12.4	13.8	12.6	14.0	12.5	13.9
CHEST DEPTH	8.1	9.6	8.0	9.5	8.5	10.2
FOOT LENGTH	9.3	9.6	9.2	9.5	11.0	11.2
HAND LENGTH	7.1	7.1	6.9	7.0	8.0	8.1
ELBOW-WRIST LENGTH	10.1	10.0	9.8	9.7	12.3	12.3

TABLE B-1: ANTHROPOMETRIC MULTIVARIATE MODELS WITH ADDITIONAL MEASURES FOR COMBIMAN (CONT'D).

	MODEL 7	MODEL 8	MODEL 9	MODEL 10	MODEL 11	MODEL 12
	GENERALIZED LARGE MALE LIGHT WEIGHT	GENERALIZED LARGE MALE HEAVY WEIGHT	MALE SHORT TORSO LONG LIMBS LIGHT WEIGHT	MALE SHORT TORSO LONG LIMBS HEAVY WEIGHT	MALE LONG TORSO SHORT LIMBS LIGHT WEIGHT	MALE LONG TORSO SHORT LIMBS HEAVY WEIGHT
WEIGHT	195.0	245.0	161.0	205.0	145.0	190.0
SITTING HEIGHT	40.0	40.0	38.0	38.0	38.5	38.5
SITTING EYE HEIGHT	35.0	35.0	32.9	32.9	33.4	33.4
SITTING ACROMION HT	26.9	26.9	25.0	25.0	25.2	25.2
SITTING KNEE HEIGHT	24.7	24.7	24.8	24.8	20.6	20.6
THUMBTIP REACH	35.6	35.6	36.0	36.0	29.7	29.7
BUTTOCK-KNEE LENGTH	27.4	27.4	27.9	27.9	22.7	22.7
SHOULDER-ELBOW LGTH	16.3	16.2	16.3	16.3	14.1	14.1
BIACROMIAL BREADTH	16.7	17.2	16.1	16.6	15.5	16.0
HIP BREADTH, STANDING	14.2	15.5	13.1	14.3	13.0	14.2
CHEST DEPTH	9.6	11.3	8.5	10.0	8.6	10.1
FOOT LENGTH	11.7	11.9	11.6	11.7	10.3	10.5
HAND LENGTH	8.3	8.5	8.3	8.4	7.4	7.5
ELBOW-WRIST LENGTH	12.7	12.7	12.9	12.9	10.9	10.9

TABLE B-2: F-16A VISION FROM THE COCKPIT - IN DEGREES*

ALL DATA HAVE BEEN DERIVED FROM THE ACCOMMODATION DATABASE.

	MULTIVARIATE MODELS					
	1&2	3&4	5&6	7&8	9&10	11&12
EYE HT SIT	28.9	30.7	30.2	35.0	32.9	33.4
SEAT FULL UP.						
FrPl O'Nose	-11	-16	-14			
Head Up/Aft	-13	-18	-16			
Over Side	-23	-28	-27			
SEAT AT -1.3 INCHES FROM FULL UP.						
FrPl O'Nose			-12			
Head Up/Aft			-14			
Over Side			-24			
SEAT AT -2 INCHES FROM FULL UP.						
FrPl O'Nose		-12				
Head Up/Aft		-14				
Over Side		-24				
SEAT AT -4 INCHES FROM FULL UP.						
FrPl O'Nose						-15
Head Up/Aft						-17
Over Side						-27

* All visions angles are rounded to the nearest degree.

TABLE B-3: F-16A RUDDER PEDAL ACCESS - INCHES OF EXCESS LEG LENGTH BEYOND THAT NEEDED
TO ACTUATE RUDDER PEDALS IN FULL AFT CARRIAGE POSITION

ALL DATA HAVE BEEN DERIVED FROM THE ACCOMMODATION DATABASE.

	MULTIVARIATE MODELS					
	1&2	3&4	5&6	7&8	9&10	11&12
BUTT KNEE L.	22.1	21.3	26.5	27.4	27.9	22.7
KNEE HT, SIT	19.5	19.1	23.3	24.7	24.8	20.6
COMBINED LEG	41.6	40.4	49.8	52.1	52.7	43.3
SEAT FULL UP						
DATABASE EXCESS LEG LENGTH	3.2	2.0				
SEAT -2 INCHES FROM FULL UP						
DATABASE EXCESS LEG LENGTH		3.7				
SEAT - 4 INCHES FROM FULL UP						
DATABASE EXCESS LEG LENGTH						8.3

TABLE B-4: F-16A LEFT HAND REACH MISS DISTANCES, ZONES 1 AND 2.* ALL DATA HAVE BEEN DERIVED FROM THE ACCOMMODATION DATABASE.

MULTIVARIATE MODELS

	SEAT FULL UP		SEAT -2 INCHES FROM FULL UP	SEAT -4 INCHES FROM FULL UP
	1&2	3&4	3&4	11&12
SHLDR HT, SIT	21.3	22.7	22.7	25.2
TH-T REACH	28.3	27.6	27.6	29.7
1. FIRE/OVERHEAT DETECT (F)				
ZONE 1	-	-1.5	-0.1	
ZONE 2	-	0.7	2.2	
2. ANTI-G TEST (F)				
ZONE 1	-	-0.4		
ZONE 2	-	1.8		
3. RUDDER ARM (T)				
ZONE 1	-	-1.3		
ZONE 2		0.9		
4. CANOPY JETTISON (T)				
ZONE 1	-	-1.4		
ZONE 2	-	0.8		
5. MAIN POWER (BATT) (T)				
ZONE 1	-	-0.8		
ZONE 2	-	1.4		
6. THROTTLE Fwd (H)				
ZONE 1	-1.4	-2.6	-1.9	
ZONE 2	2.2	1.0	1.7	

* Controls listed are those for which Zone 1 miss distances (negative values) are found. This list is not all inclusive. It is taken from a sampling of controls. Controls that are not listed should not necessarily be considered accessible under Zone 1 restraint conditions.

TABLE B-4: F-16A LEFT HAND REACH MISS DISTANCES, ZONES 1 AND 2. (CONT'D)

M U L T I V A R I A T E   M O D E L S

	SEAT FULL UP		SEAT -2 INCHES FROM FULL UP	SEAT -4 INCHES FROM FULL UP
	1&2	3&4	3&4	11&12
SHLDR HT, SIT	21.3	22.7	22.7	25.2
TH-T REACH	28.3	27.6	27.6	29.7
7. EEC Off/Buc (F)				
ZONE 1	-0.2	-1.1	-0.8	
ZONE 2	3.4	2.5	2.8	
8. UHF PRESET				
ZONE 1	-0.1	-1.4	-0.6	
ZONE 2	3.5	2.2	3.0	
9. JET FUEL START #2 (T)				
ZONE 1	-2.6	-3.9	-3.1	-1.2
ZONE 2	1.0	-0.3	0.5	2.4
10. RADAR L-BAR (F)				
ZONE 1	-1.7	-2.8	-2.2	-0.2
ZONE 2	1.9	0.8	1.4	3.4
11. MANUAL PITCH OVERRIDE (F)				
ZONE 1	-2.4	-3.4	-3.0	-1.0
ZONE 2	1.2	0.2	0.6	2.6
12. STORAGE CONFIG CAT 1 (F)				
ZONE 1	-3.0	-3.8	-3.7	-1.6
ZONE 2	0.6	-0.2	-0.1	2.0
13. DOWNLOCK RELEASE (F)				
ZONE 1	-3.0	-3.6	-3.8	-1.6
ZONE 2	0.6	0.0	-0.2	2.0

TABLE B-4: F-16A LEFT HAND REACH MISS DISTANCES, ZONES 1 AND 2. (CONT'D)

MULTIVARIATE MODELS

		SEAT FULL UP		SEAT -2 INCHES FROM FULL UP	SEAT -4 INCHES FROM FULL UP
		1&2	3&4	3&4	11&12
SHLDR HT, SIT		21.3	22.7	22.7	25.2
TH-T REACH		28.3	27.6	27.6	29.7
14. EMERGENCY STORES JETTISON (F)					
	ZONE 1	-4.7	-5.1	-5.6	-3.4
	ZONE 2	-1.1	-1.5	-2.0	0.2
15. PITCH ALT HOLD (F)					
	ZONE 1	-4.7	-5.2	-5.4	-3.3
	ZONE 2	-1.1	-1.6	-1.8	0.3
16. IFF IDENT (F)					
	ZONE 1	-5.2	-5.7	-5.9	-3.8
	ZONE 2	-1.6	-2.1	-2.3	-0.2
17. MASTER CAUTION (F)					
	ZONE 1	-2.2	-3.6	-2.6	-0.7
	ZONE 2	2.1	0.7	1.7	3.6
18. DIS/LTS (T)					
	ZONE 1	-8.3	-9.6	-8.8	
	ZONE 2	-4.0	-5.3	-4.5	
19. SELECT JETTISON (F)					
	ZONE 1	-7.6	-8.3	-8.3	-6.2
	ZONE 2	-3.3	-4.0	-4.0	-1.9
20. SHIFT (MFD) (F)					
	ZONE 1	-7.0	-7.9	-7.6	-5.5
	ZONE 2	-2.7	-3.6	-3.3	-1.2

TABLE B-4: F-16A LEFT HAND REACH MISS DISTANCES, ZONES 1 AND 2. (CONT'D)

MULTIVARIATE MODELS

	SEAT FULL UP		SEAT -2 INCHES FROM FULL UP	SEAT -4 INCHES FROM FULL UP
	1&2	3&4	3&4	11&12
SHLDR HT, SIT	21.3	22.7	22.7	25.2
TH-T REACH	28.3	27.6	27.6	29.7
21. HUD FILTER (T)				
ZONE 1	-5.2	-5.9	-5.9	-3.8
ZONE 2	-0.9	-1.6	-1.6	0.5
22. HUD MILS-DEPR (T)				
ZONE 1	-7.0	-7.4	-7.9	-5.7
ZONE 2	-2.7	-3.1	-3.6	-1.4
23. AIR SPEED/MACH IND (T)				
ZONE 1	-9.1	-9.9	-9.7	
ZONE 2	-4.8	-5.6	-5.4	
24. TACAN HEADING (T)				
ZONE 1	-7.3	-8.5	-7.8	-5.9
ZONE 2	-3.0	-4.2	-3.5	-1.6
25. COURSE SELECT (T)				
ZONE 1	-8.7	-10.0	-9.2	
ZONE 2	-4.4	-5.7	-4.9	
26. HSI Pull to Cage (T)				
ZONE 1	-11.6	-12.2	-12.3	-10.2
ZONE 2	-7.3	-7.9	-8.0	-5.9
27. ALTIMETER Select (F)				
ZONE 1	-10.1	-10.4	-10.9	
ZONE 2	-5.8	-6.1	-6.6	

TABLE B-4: F-16A LEFT HAND REACH MISS DISTANCES, ZONES 1 AND 2. (CONT'D) FULL-UP SEAT ADJUSTMENT

M U L T I V A R I A T E   M O D E L S

	SEAT FULL UP		SEAT -2 INCHES FROM FULL UP	SEAT -4 INCHES FROM FULL UP
	1&2	3&4	3&4	11&12
SHLDR HT, SIT	21.3	22.7	22.7	25.2
TH-T REACH	28.3	27.6	27.6	29.7
28. <u>FUEL QUANT SELECT (T)</u>				
ZONE 1	-14.4	-15.8	-14.8	-12.9
ZONE 2	-10.1	-11.5	-10.5	-8.6

TABLE B-5: F-16A RIGHT HAND REACH MISS DISTANCES, ZONES 1 AND 2.

ALL DATA HAVE BEEN DERIVED FROM THE ACCOMMODATION DATABASE.

		MULTIVARIATE MODELS			
		SEAT FULL UP		SEAT -2 INCHES FROM FULL UP	SEAT -4 INCHES FROM FULL UP
		1&2	3&4	3&4	11&12
SHLDR HT, SIT		21.3	22.7	22.7	25.2
TH-T REACH		28.3	27.6	27.6	29.7
CONTROL & (HAND INTERFACE)		REACH MISS DISTANCES (IN INCHES).			
28. FUEL QUANT SELECT (T)					
	ZONE 1	-6.6	-7.4	-7.2	-5.2
	ZONE 2	-4.3	-5.1	-4.9	-2.9
29. CONTROL GRIP (G)					
	ZONE 1	-	-0.2		
	ZONE 2	-	2.1		
30. ILS VOL (T)					
	ZONE 1	-3.1	-4.2	-3.7	-1.7
	ZONE 2	-0.8	-1.9	-1.4	0.6
31. SUIT PRESSURE (F)					
	ZONE 1	-1.1	-2.0	-1.7	
	ZONE 2	1.2	0.3	0.6	

* Controls listed are those for which Zone 1 miss distances (negative values) are found. This list is not all inclusive. It is taken from a sampling of controls. Controls that are not listed should not necessarily be considered accessible under Zone 1 restraint conditions.

TABLE B-6: F-16A OVERHEAD CLEARANCE DATA - IN INCHES.

ALL DATA HAVE BEEN DERIVED FROM THE ACCOMMODATION DATABASE.

SEAT FULL UP	MULTIVARIATE MODELS					
	1&2	3&4	5&6	7&8	9&10	11&12
Sitting Height	34.0	35.5	34.9	40.0	38.0	38.5
Overhead Clearance (From Helmet)	3.2	1.7	2.3			
Remaining Downward Seat Adjust	5.0	5.0	5.0			
Maximum Sitting Ht. Accommodated	**42.2**	**42.2**	**42.2**			

SEAT -2" FROM FULL UP	MULTIVARIATE MODELS					
	1&2	3&4	5&6	7&8	9&10	11&12
Sitting Height	34.0	35.5	34.9	40.0	38.0	38.5
Overhead Clearance (From Helmet)		3.4				
Remaining Downward Seat Adjust		3.0				
Maximum Sitting Ht. Accommodated		**41.9**				

SEAT -4" FROM FULL UP	MULTIVARIATE MODELS					
	1&2	3&4	5&6	7&8	9&10	11&12
Sitting Height	34.0	35.5	34.9	40.0	38.0	38.5
Overhead Clearance (From Helmet)						2.1
Remaining Downward Seat Adjust						1.0
Maximum Sitting Ht. Accommodated						**41.6**

TABLE B-6: F-16A OVERHEAD CLEARANCE DATA - IN INCHES (CONT'D).

ALL DATA HAVE BEEN DERIVED FROM THE ACCOMMODATION DATABASE.

SEAT -1.3" FROM FULL UP	MULTIVARIATE MODELS					
	1&2	3&4	5&6	7&8	9&10	11&12
Sitting Height	34.0	35.5	34.9	40.0	38.0	38.5
Overhead Clearance (From Helmet)			3.4			
Remaining Downward Seat Adjust			3.7			
Maximum Sitting Ht. Accommodated			**42.0**			

SEAT FULL DOWN	MULTIVARIATE MODELS					
	1&2	3&4	5&6	7&8	9&10	11&12
Sitting Height	34.0	35.5	34.9	40.0	38.0	38.5
Overhead Clearance (From Helmet)					3.5	
Remaining Downward Seat Adjust					0.0	
Maximum Sitting Ht. Accommodated					**41.5**	

TABLE B-7: F-16A OPERATIONAL SHIN CLEARANCE WITH MAIN INSTRUMENT PANEL

ALL DATA HAVE BEEN DERIVED FROM THE ACCOMMODATION DATABASE.

SEAT FULL UP	MULTIVARIATE MODELS					
	1&2	3&4	5&6	7&8	9&10	11&12
Buttock Knee Lth	22.1	21.3	26.5	27.4	27.9	22.7
Shin Clearance with MIP			0.5			
Maximum Buttock Knee L. Accom-modated.			27.0			

SEAT -1.3" FROM FULL UP	MULTIVARIATE MODELS					
	1&2	3&4	5&6	7&8	9&10	11&12
Buttock Knee Lth	22.1	21.3	26.5	27.4	27.9	22.7
Shin Clearance with MIP			0.5			
Maximum Buttock Knee L. Accom-modated.			27.0			

SEAT FULL DOWN	MULTIVARIATE MODELS					
	1&2	3&4	5&6	7&8	9&10	11&12
Buttock Knee Lth	22.1	21.3	26.5	27.4	27.9	22.7
Shin Clearance with MIP					-0.9	
Maximum Buttock Knee L. Accom-modated.					27.0	

TABLE B-8: CLEARANCE BETWEEN THE KNEES AND THE GLARE SHIELD, F-16A - IN INCHES

ALL DATA HAVE BEEN DERIVED FROM THE ACCOMMODATION DATABASE.

SEAT FULL UP	MULTIVARIATE MODELS					
	1&2	3&4	5&6	7&8	9&10	11&12
Buttock Knee Lth	22.1	21.3	26.5	27.4	27.9	22.7
Knee Clearance Glare Shield			3.0			
Maximum Buttock Knee L. Accommodated.			29.5			

SEAT -1.3 FROM FULL UP	MULTIVARIATE MODELS					
	1&2	3&4	5&6	7&8	9&10	11&12
Buttock Knee Lth	22.1	21.3	26.5	27.4	27.9	22.7
Knee Clearance Glare Shield			3.0			
Maximum Buttock Knee L. Accommodated.			29.5			

SEAT FULL DOWN	MULTIVARIATE MODELS					
	1&2	3&4	5&6	7&8	9&10	11&12
Buttock Knee Lth	22.1	21.3	26.5	27.4	27.9	22.7
Knee Clearance Glare Shield					1.6	
Maximum Buttock Knee L. Accommodated.					29.5	

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